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The Copper Queen Smelting Works

By Richard H. Vail

SYNOPSIS—An account of the important smelting operations conducted by the Phelps-Dodge interests at Douglas, Ariz. This was the first large copper works in the United States to bed its blast-furnace stock. The plant now comprises 10 blast furnaces, seven upright converters, nine McDougal roasters and three reverberatory furnaces. Seven more roasters are being built on account of the increased amount of sulphide ore from the Bisbee mines. A new skullbreaker and copper-casting furnace will probably be added. The method of converter-slag disposal is unique and has effected an important saving.

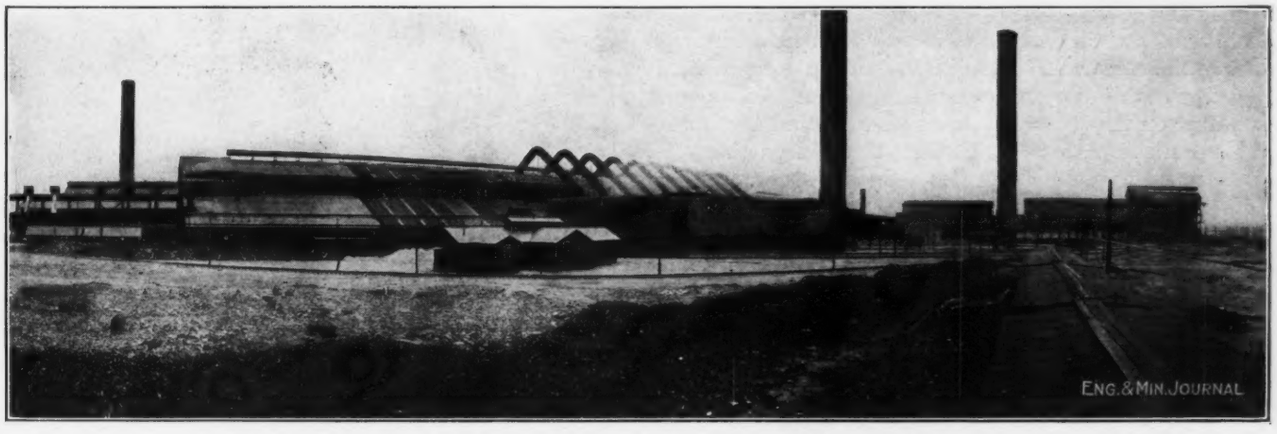
The Copper Queen smelting works at Douglas, Ariz., treats the ore from this company's important group of mines at Bisbee and from the Phelps-Dodge mines in other parts of Arizona, as well as the concentrates from its Nacozari property, the Moctezuma Copper Co., near Nacozari, Sonora, Mex. The company also treats custom ore at its works, which is built on a level site about one mile northwest of Douglas. The plant now comprises 10 blast furnaces, nine 18-ft. McDougal roasting furnaces, three reverberatory furnaces, 19x91½ ft., and seven 12-ft. upright converters, basic lined. The works treated in 1913 over a million tons of new copper-bearing material and produced 133,410,582 lb. of copper, besides over $1,500,000 worth of gold and silver.

The Douglas plant started operating in 1904, at which time five blast furnaces and four converters were installed. The plant was doubled in 1906, and during the last two years the eight acid-lined converters have been supplanted by seven basic-lined upright converters of the Great Falls type. Owing to a change in ore conditions—more fine ores and a greater proportion of sulphides—it also became necessary to install roasting furnaces and reverberatories to handle the Nacozari concentrates and flue dust. Notwithstanding these equipment extensions, the grade of the matte has fallen to from 30 to 35%, due to the greater amount of sulphur in the ores.

Ores Bedded in Rock-Walled Pits

The ores smelted at Douglas vary greatly in composition, the most objectionable ingredient being alumina. As many of the ores are of a clayey character, it was decided when this works was built to avoid the use of bins as it was likely that the ores would "hang up." On account of the wide variation in the ores from the Copper Queen mines, an effort is made to mix each lot of ore as it is loaded at Bisbee. This is accomplished by means of an automatic tripper conveyor, and when these lots arrive at the Copper Queen works, they are dumped into one of five rock-walled pits or beds. The only trestle bins at this plant are those for coke and for miscellaneous fluxes, for which a steel structure was provided.

The five rock-walled pits for the ores are 38 ft. wide by 750 ft. long, and 11 ft. deep. When these pits were established, bedding was not the usual practice for copper ores. In fact, this was the first large copper-smelting



The Enlarged Copper Queen Smelting Works, Douglas, Arizona

Power house at left, then general smelting building, converter and blast-furnace stack, reverberatory and roaster dust chambers and stack; McDougal roaster building at extreme right.

plant to establish a bedding system in this country, though a number of plants in the Southwest have since installed the Messiter bedding and reclaiming system.

At the Copper Queen works, the greater part of the ore smelted comes from the company's mines at Bisbee. This is usually sent in lots of seven 50-ton cars and a sample car which goes to the sampling mill situated west of the ore pits. This mill has a capacity of 150 tons in 8 hr. and all ores after sampling are returned to the ore pits. Most of the Copper Queen ores arrive in side-dumping steel cars that may be discharged directly into the ore pit. After unloading a group of cars, the ore beds are periodically leveled by the use of a mechanical plow which has been rigged up on an ordinary flat-car and is moved by an electric motor. One of these plows is shown in action by the accompanying engraving. Converter slag and other fluxes (if necessary) are added so that the completed beds constitute a self-fluxing mixture.

The blast-furnace charges are usually drawn from two of the beds while the other three beds are in process of making. The bedded ore is picked up by means of Thew steam shovels, of which six have been provided, although one is generally used for miscellaneous service throughout the works. These are No. 3 Thew steam shovels with a 32-ft. boom and a 1¼-ton dipper. The furnace-charge trains consist of a Baldwin-Westinghouse 13-ton locomotive and 20 side-roll-dump cars of 66 cu.ft. capacity. The charge train runs on the track alongside the ore pit, while the steam shovel has a track on the bottom of the ore pit and cleans out the pit as it proceeds. One dipperful of the ore mixture is put in each car, and the loading of a train of 20 cars usually requires an average of 10 min. per train. At each pit, there are six men engaged in this service, comprising a motorman and swamper on the charge train, an engineer and fireman on the steam shovel, and two laborers in the pit to keep the ore cleaned up behind the steam-shovel dipper. As two beds are operated, the total force of men on this work per day is thirty-six.

After leaving the ore pit, the charge train stops under the coke bin, and coke amounting to about 12.4% of the charge is dropped on top of the ore cars from suspended spring-scale hoppers. When the charge train comes under the coke bins the train is "spotted" so that the weighing hoppers dump directly into the cars and only about two minutes are required for loading the coke. The charge train then proceeds to the feed-floor level, where the electric locomotive uncouples, leaves the loaded charge train standing on the trestle at the feed-floor level, and picks up the empty trains which have been switched out of the furnace building by a 15-ton Baldwin-Westinghouse locomotive that handles all loaded trains delivered to the trestle level.

Flue Dust Now Reduced to 3.92% of Charge

The stock is fed to the furnace by tilting the charge cars, one feeder attending to two furnaces with the assistance of a Mexican laborer for each furnace. The present charge is a difficult one for the blast furnaces, owing to its fineness and its high alumina content.

There are 10 blast furnaces, 44 in. wide at the tuyeres; five are 18 ft. long and the others 20 ft. long. Drawings of these furnaces have been prepared in considerable detail in the Journal[1], but it may be mentioned that the furnaces are no longer tapped intermittently; the change to continuous flow was made in 1908 (?), the blast now being trapped by a mud dam in a water-jacketed trough spout. The steel superstructure of the furnaces is brick lined, and the gases pass to the dust chamber through 8-ft. downtakes. The furnaces have 4-in. tuyeres spaced 12 in. apart, two of which are served by one blast pipe, the air being controlled by a valve of the stop-cock type. Air is received from a 42-in. blast main which divides into two 30-in. branches. The water consumption per furnace per minute is about 400 gal., when the water leaves the jacket at a temperature between 110° and 120° Fahrenheit.

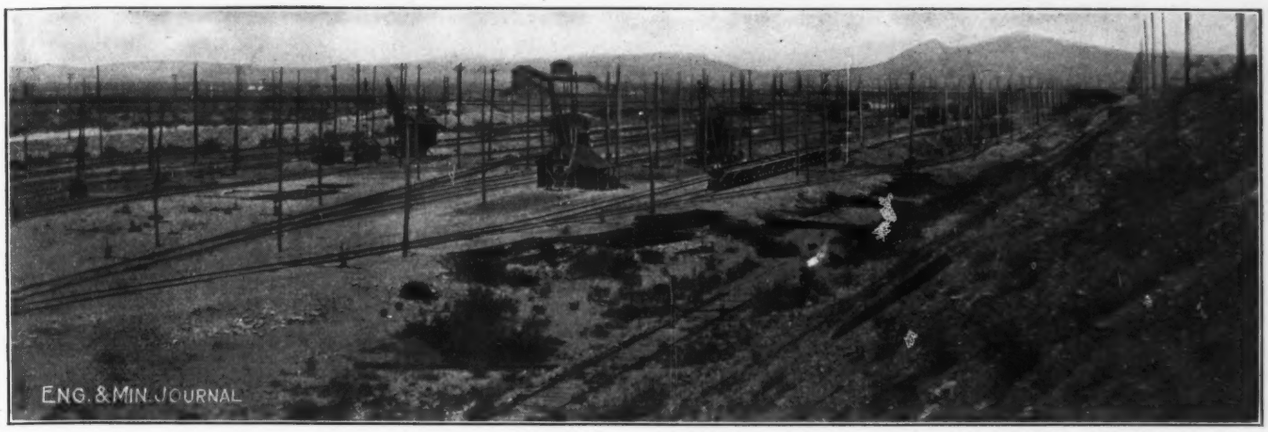
The furnaces have oval settlers 12x20 ft. and 10x23 ft.; these are set at right angles to the long axes of the furnaces. The slag is removed in 140-cu.ft. motor-tilted slag pots, drawn by electric locomotives. The copper in the slag is usually equivalent to about 0.01 of the matte content, but when the copper in the matte exceeds about 43%, the slag loss increases abnormally and this is consequently regarded as the economic limit of concentration.

The furnace tops are kept in good condition, notwithstanding the nature of the charge and the mechanical

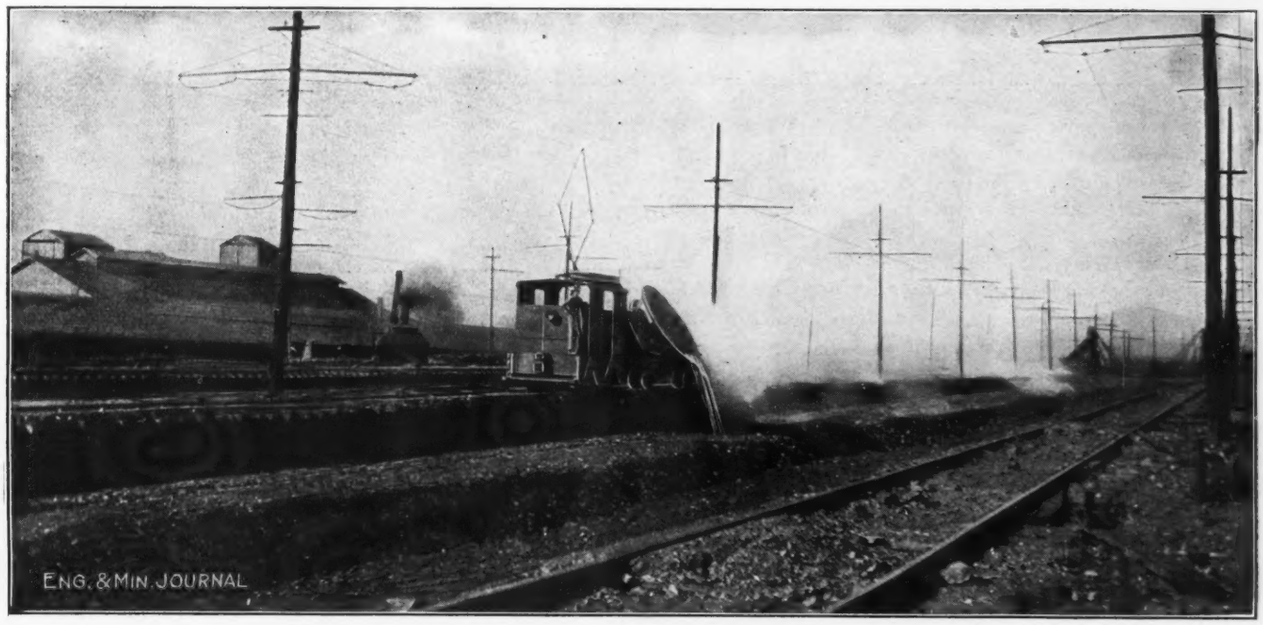
The Ore Beds Are Periodically Leveled by the Plow

feeding of same. Owing to the fineness of the charge, a low blast pressure—about 28 oz.—is used. The ores are friable and inclined to make a large quantity of flue dust. The blast-furnace flue dust carries about 7.5% Cu, 22% SiO_2, 27% Fe, 9.6% Al_2O_3, 10% S, 1.3% CaO. Before the velocity in the main dust chamber was reduced to 5 ft. per sec. and the Nacozari concentrates treated in reverberatories, the flue dust amounted to 7.59% of the furnace charge. At present, it amounts to about 3.92%. These excellent results have been attained following an exhaustive study of the dust-settling problem at this works and the installation of a reverberatory furnace to treat the fines. The stack loss has been reduced to 2589 lb. of copper in 24 hr., according to a test made in September, 1913. The other metals lost through the stack were: Silver, 64.2 oz.; lead, 2286 lb.; zinc, 2808 pounds.

[1]"Eng. and Min. Journ.," Vol. LXXXII, p. 298.

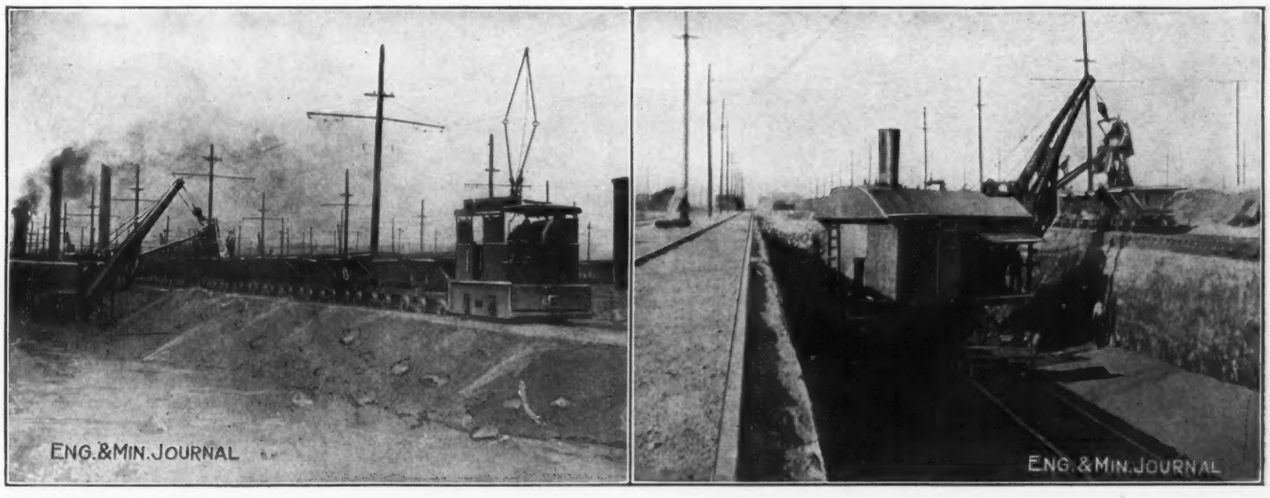


VIEW OF ORE BEDS FROM COPPER QUEEN WORKS



POURING MOLTEN CONVERTER SLAG ON ONE OF THE ORE BEDS

This slag was formerly poured on the ground, broken and loaded in cars by hand, and added to the furnace charge, about 50 men being required for converter-slag disposal. Now the molten slag is poured on the ore beds as the latter are being made, only six men being required for this work. The steam shovels experience no difficulty in digging the thin layers of solidified slag.



LOADING THE FURNACE CHARGE TRAINS

A charge train comprising 20 cars is loaded in 10 min., the steam shovels dropping one dipperful in each car. Two men clean up the bottom of the rock-walled pit behind the steam-shovel dipper, shoveling the ore forward to the main bank.

The matte fall ranges from 18 to 20%, and for a recent month was 20.9%. The slag averaged SiO_2, 35%; Al_2O_3, 12.2; FeO, 42.9; CaO, 3.1; MgO, 2.5; Cu, 0.39%. The slags used are high in alumina, and the combined silica-and-alumina limit is set at 48%. The maximum alumina for good running is 12%. Lime flux was abandoned about four years ago and since then no limerock is added regularly to the beds or as flux. Converter slag is used in place of limerock as flux and in consequence the FeO contents of the slag are high, and the CaO correspondingly lower. The average matte analysis for the month was: Cu, 33.4%; Ag, 6 oz.; Au, 0.1 oz. The coke on charge was 12.7%, and the sulphur 12.5%, the copper 6.7%, and the alumina 7.4%. The average blast pressure for the month was 27 oz. and 69,287 cu.ft. of free air were used per ton of charge. The average tonnage of the furnaces was 340 tons or an equivalent of 4.85 tons per sq.ft. of hearth area. An average of 8.08 furnaces were operated last year.

More Roasters Contemplated

There are nine water-cooled McDougal roasters for calcining the Nacozari concentrates, and on account of the increased amount of sulphide ores coming from the Bisbee mines it has been decided to build seven more McDougals. The roasters now in use have six hearths and are 18 ft. in diameter. The Nacozari and other concentrates are usually received in flat-bottom cars that are emptied by shoveling the concentrates into bins under which there is a conveyor leading to a bucket elevator. The latter delivers to an automatic-tripper conveyor that keeps the hoppers supplied with concentrates. When the roasting furnaces were first installed, they were run at a rate of about 68 to 78 tons per day. This was later reduced to 58 tons; when all the furnaces are in operation, the best results are obtained with a duty of about 50 tons per furnace.

The concentrates contain about 32.5% of sulphur, which is reduced to 11% in the McDougal furnaces. The shrinkage in tonnage resulting from roasting is about one-sixth. Practically no fuel is used, except a little oil at the time of starting. About 5.2% of dust is made in the roasters, this being collected in a dust chamber, 42 ft. wide by 144 ft. long, having a cross-sectional area of about 1200 sq.ft. The calculated velocity of the gas flow in the chamber is about 4 ft. per sec. The dust chamber is built of hollow tile and steel, and has wires suspended at intervals of 3¾ in. from chains hung at 6-in. centers.

Reverberatory Furnaces

There are three reverberatory furnaces 19x91½ ft., each equipped with two 520-hp. Erie City water-tube waste-heat boilers. When first started, siliceous fettling, carrying about 80% SiO_2, was used and the furnaces smelted about 229 tons per day, difficulty being experienced with siliceous floaters. The present fettling is siliceous sulphide ores from Bisbee, and flue dust; the ores contain about 15% S, 7% Cu and 23% SiO_2. For the side walls and bridge, these fettling materials are used exclusively, being dropped through the roof; but quartz is thrown in at the throat. With this fettling, the tonnage has increased to 300 tons per day as an average, with occasionally 320 tons for a period of a few days. Fettling with oxidized copper ores resulted in metal loss. It is expected that the new No. 3 furnace, which has about 18 in. of magnesite brick at the slag line, will not require fettling at the throat, but the usual fettling material is dropped along the sides of the furnace.

The charge smelted consists of about three parts calcines, one of flue dust and one of fettling ores. No barren flux is added. The matte fall for a recent month was 31%; the average copper tenor of the matte about 36%, with a slag carrying 37.8% SiO_2, 11.9% Al_2O_3, 39.2% FeO, 1.7% CaO, 0.5% Cu. This was when fettling with Bisbee sulphides; when fettling with oxidized ore and making practically the same slag, the copper content was sometimes as high as 0.56%. The oil consumption is usually about 0.9 bbl. per ton of charge smelted, and occasionally is as low as 0.8 bbl. per ton. The oil is heated by exhaust steam to 175° F., and is atomized in the furnaces by air at 11-lb. pressure.

The reverberatory gases are received in a dust chamber 132 ft. long, built of hollow tile and steel. The first and last bays of the dust chamber have baffles, but in the other bays are steel wires 3¾ in. apart suspended from chains hung at 6-in. centers. Little dust, however, is made by the reverberatory furnaces. In the reverberatory boiler room there are, besides the boiler-feed pumps, two Aldrich triplex electrically driven pumps for supplying cooling water to the roasting furnaces.

Converting in Upright Shells

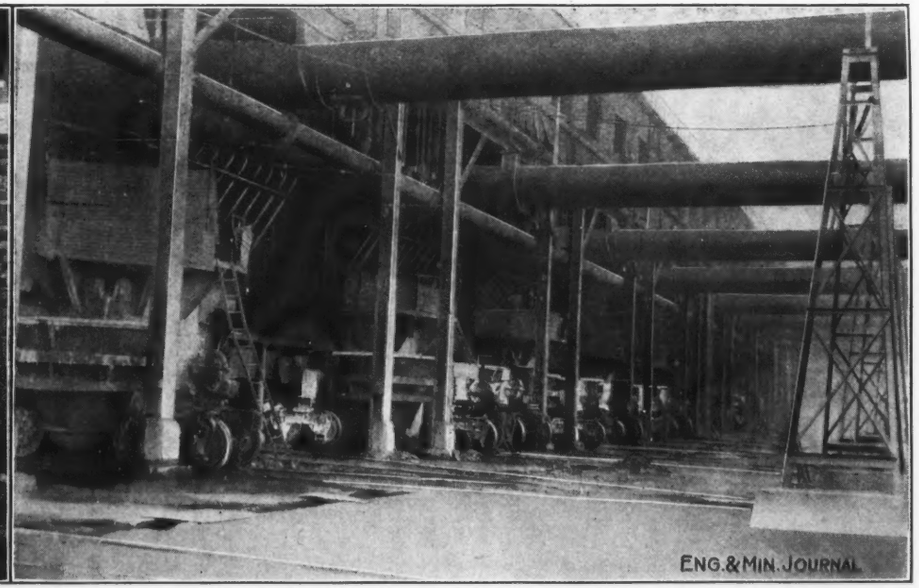
The converting department at Douglas formerly comprised eight barrel-type converters, 8x11½ ft. In 1912 was begun the gradual replacement of the barrel converters by seven 12-ft. upright converters having concentric mouths. During the reconstruction, most of the copper production was made in four of the upright stands. The converters were crowded at this period and in consequence collar troubles were experienced, but these have since decreased, with the greater leisure obtained by the operation of the seven upright stands. A collar puller of the Old Dominion type is used.

The matte is brought from the reverberatory and blast furnaces in ladles holding 80 cu.ft. The practice in starting a converter is to blow the first ladle, or even two or three ladles without silica, to form a coating of Fe_3O_4; then about one ton of siliceous ore, carrying 74% SiO_2, is added and about six tons of 40% matte. The dished bottom of the converter is 16 in. below the tuyeres, at the center. Some slopping of the converters occurs, amounting perhaps to 5% when the converting capacity is crowded. The converter slag as skimmed contains about 1.5% copper, but including all white metal and cleanup, it carries about 5% copper, 22.2% SiO_2, 45.7% Fe, 2.5% Al_2O_3. Ordinarily, two punchers are employed for each of the upright converters, and one skimmer to two converters. A head skimmer is also employed to assist anywhere in the converting operation. As a rule, the converters are operated at high speed.

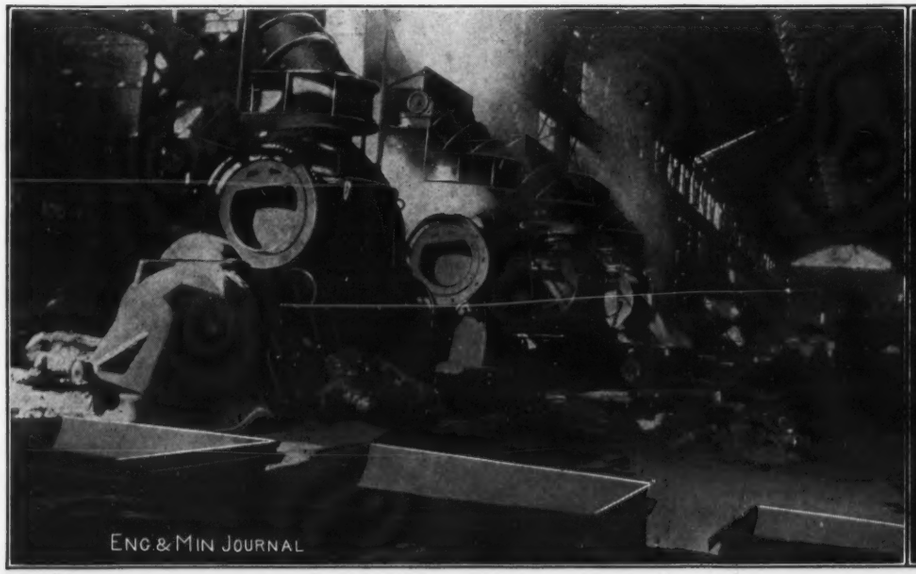
Novel Disposal of Converter Slag

In 1913, Superintendent Rutherford introduced a new method of disposing of the converter slag, which at this plant is needed for fluxing the blast-furnace charge; the slag is now poured on the ore beds. Formerly about 45 Mexicans were employed in breaking and loading converter slag for transfer to the blast-furnace bins. About

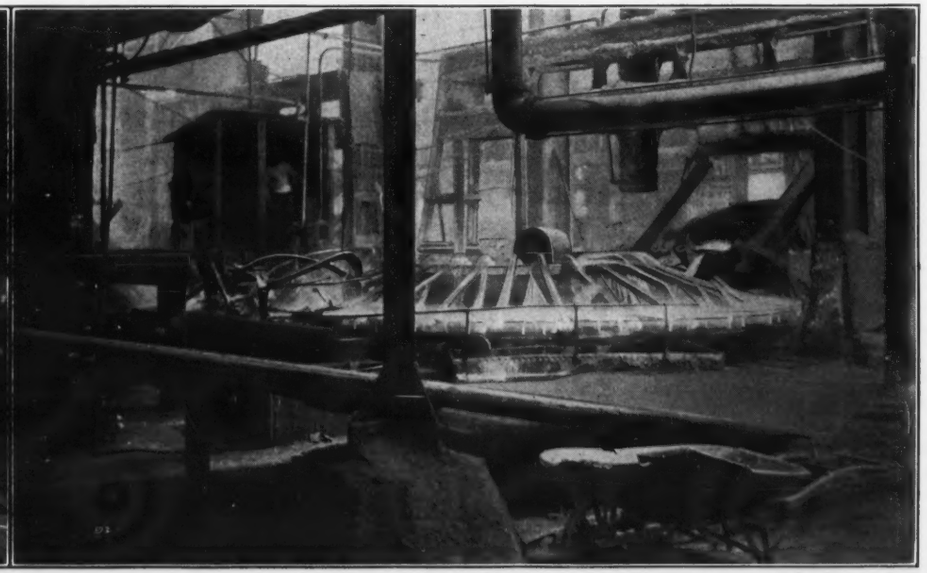
TAKING A TAP FROM THE REVERBERATORY FURNACES
The Copper Queen plant has three oil-fired reverberatories, each 19x91½ ft.



COPPER QUEEN BLAST FURNACES
Slag is removed in 140-cu.ft. motor-tilted pots, drawn by electric locomotives.



THERE ARE NOW SEVEN UPRIGHT CONVERTERS AT DOUGLAS



CASTING THE CONVERTER COPPER IN A WALKER WHEEL

40 of these men have been eliminated by the new method, effecting a saving of about $60 per day.

Now two men, a motorman and swamper, are all that are required for the disposal of the molten slag. The slag is hauled to the tracks alongside the ore beds, and as the motor moves along the bed, the slag pot is slowly tilted so that its contents are spread over the ore bed in a thin layer. Before the slag layer becomes too thick, more ores are unloaded. The thickness of the slag layer is usually from one to two inches and when loading from the beds, the steam shovels have no difficulty in cutting the bank of ore containing the thin layers of solidified slag.

Important Saving in Converter-Slag Disposal

One of the accompanying illustrations shows the converter slag being poured on the bed. This method of converter-slag disposal, while not applicable to other smelting plants, has admirably disposed of the problem at this works. Summarized briefly, it has eliminated the breaking and loading by hand of approximately 100,000 tons of material per annum.

When the method was first tried, two men were required at the beds to prevent the hot slag setting fire to the railroad ties and wooden trolley poles. Steel ties and steel-sheathed trolley poles have solved the fire problem, and at present only six men are now employed in converter-slag disposal as against about 50 men employed on this work at the beginning of 1913. The converter slag shells have still to be broken, but it is contemplated that these will be disposed of by the new skullbreaker which is to be erected in the main smelting building.

The finished copper charge is poured into two small ladles and taken by electric traveling crane to the pouring stands of two Walker casting wheels, 21 ft. in diameter. The bullion ladles are too small for the present operation with upright converters, two being required in order to take the usual charge from the converter, thus involving extra crane service and often unnecessary delay. However, with the present ample converting capacity, this does not cause the inconvenience that was apparent during the construction period when only four upright-converter stands were available.

The erection of a copper-casting furnace to facilitate the handling of the converter copper is under consideration. Other improvements contemplated in the converting department include a tower to remove crane trolleys. There are four electric traveling cranes in this department, all of 60-ton capacity.

About 40 tons of copper are produced per day per converter. The copper bullion averages 99.2% copper, 0.4 oz. gold, 28 oz. silver. Normally from eleven to twelve million pounds of bullion are produced per month. In 1913, nearly 50,000 tons of siliceous ores were smelted in the converters as flux.

Power Plant

In the main boiler house at Douglas, there are eight 500-hp. water-tube boilers, but since the installation of the reverberatory waste-heat boilers, only four to five of the power-house boilers are regularly used. They are equipped with economizers; all steam generated is superheated in a separately fired Foster superheater to 460° F. and reaches the engines at about 410° F. No feedwater heaters are used, the feed water being drawn from the condenser hotwell. The reverberatory waste-heat boilers are credited with the utilization of 34.57% of the heat developed by the oil burned in the reverberatory furnaces; the oil used is California crude containing 18,400 B.t.u. per lb. and weighing 8.05 lb. per gal. at 60° F. The oil consumed in the boiler plant is 1.125 lb. per indicated horsepower-hour delivered by the power plant.

Air is supplied to the blast furnaces at 28 oz. pressure by 11 rotary blowers direct connected to Nordberg tandem-compound engines. A feature of the blast service at this plant is that each furnace's air supply is received from an individual blower unit, though valve connections are such that a blower can supply air to either of two furnaces, or all the blast-furnace air can be delivered to a common main.

There are five No. 9 Connersville blowers operating at 78 to 90 r.p.m., and six No. 10 Connersville blowers, operating at 56 to 66 r.p.m. There are also two No. 7 Connersville blowers, arranged for electric-motor driving, that are not used at present. Converter air is supplied to a common main at 12½- to 13-lb. pressure by seven Nordberg cross-compound engines, five of which deliver from 4000 to 6000 cu.ft. each and two deliver 12,000 cu.ft. each per minute.

To develop the electric power used within the works, there are four 400-kw. 260-volt direct-current generators direct connected to cross-compound engines. The current is used by 14 electric locomotives, 7 electric cranes and about 60 stationary motors. The exhaust steam from the reciprocating engines may be delivered to condensers or to one of two 750-kw. mixed-pressure turbogenerators, which produce 60-cycle, three-phase, 2300-volt alternating current; this is stepped up to 44,000 volts and transmitted to El Tigre mine, 67 miles distant in Sonora.

The average daily power developed in the Douglas power plant in 1913 was 4595 i.hp., which required 13.65 ib. of steam per indicated horsepower. About 6% of the power is used in the accessories of power generation, such as boiler-feed pumps, water-circulating and air pumps, lighting of boiler and power houses, etc. The cost of a horsepower in 1913 was $54.84 per year.

The Copper Queen reduction works are under the direction of S. W. French, general manager of the Copper Queen Consolidated Mining Co.; G. H. Dowell, assistant general manager; and Forest Rutherford, superintendent. An average of 1039 men was employed at the works in 1913, equivalent to one man for every 1149 tons of charge, or one man to every 999 tons of new marginal material smelted.

Hancock Consolidated

The Hancock Consolidated Mining Co., Hancock, Mich., according to its report for 1913, produced 212,089 lb. of copper, which it sold for $33,912. In addition to receipts from metal produced, it received $13,280 from assessments and borrowed $165,000. Total expenditures amounted to $206,414, leaving a balance of $5778 on hand at the end of the year. The company now owes notes amounting to $260,000 and accounts amounting to $33,-146. Against these liabilities it has cash, supplies and accounts receivable amounting to $28,502, making a balance of $264,644 in liabilities. The mill treated 12,612 tons of rock, yielding 16.82 lb. of copper per ton.

Hydro-Electric Plant at a Bolivian Tin Mine

By Mark R. Lamb*

SYNOPSIS—The building of a dam to supply power for a tin-mining operation in a country of great altitude and no constant water supply. Rivers are alternately dry and torrential in the different seasons. Native laborers are exceedingly unsatisfactory, since they are indolent and insufficiently nourished. European power-generating machinery is used to equip the plant.

The installation described here is that of the Cia. Estañífera de Llallagua, in Bolivia, South America. The first project for a dam was for a height of 50 m., and the estimated cost was $145,000, not including the cost of the cement placed on the job. It is impossible to calculate the cost of transportation, which is necessarily by llamas. Later modifications, at the request of the directors who desired to increase the power to accord with the increased development at the mine, were such that the height was increased to 58 m. above bed rock. Lack of facilities for such work, together with its isolated situation, were the causes of an unexpected increase in its cost. It should be said in general that in that part of Bolivia, so distant from the coast, it is utterly impossible to complete such a job at the ordinary calculated cost. There are too many factors which unexpectedly increase expenses.

Difficulties of Transportation

Transportation difficulties are great. Every piece of freight must be handled at least 10 times between the coast and the job, and this handling is done without the usual conveniences and without any consideration for the nature of the material. The roads and trails are scarcely deserving of the names, and it is difficult to transport delicate parts without damage. Important articles made of glass and brass are broken, lost or stolen, and often require months to replace. Due to the distance from the coast there are delays, losses of liquids, damage to cement, and total loss of some packages which can only be replaced by ordering from the factories. As a case in point, I may mention three large transformers which reached the job without a drop of oil. Oil for refilling consisted of the contents of 70 drums, and had to be ordered by cable. The same difficulty occurred with the marble switchboard, not a panel arriving in good condition in spite of its special packing.

Native Labor Unsatisfactory

Suitable labor is usually scarce. In starting the dam construction it was found necessary to recruit in the various mining districts and Indian towns, and to pay an increased wage from the beginning. The wages varied from 80c. to $1.60 per day. Wages are actually paid in bolivianos, which have a fixed gold value of 39c. U. S. currency. Bolivia, like all other countries, is issuing a paper money since the beginning of the war, and the value of the bolivianos will undoubtedly diminish.

The Indians, as well as the half-breeds, live almost exclusively on cocoa, which they chew during the entire day. While cocoa is a stimulating food, it is insufficient for a working man who expects to do any real labor. The result is that the Bolivian workman on the high plateau is not the equal of laborers elsewhere, and this is easily seen where heavy lifting or other muscular effort is required.

A large number of religious holidays and their long duration take the laborer away from his work much of the time, and it is only possible to count on 200 working days in the year. Pay day is more certainly a day of no work than a holiday, since wages must be spent as quickly as received.

Mouth of the Waste Tunnel. Mr. Ghigliotto, Manager of the Llallagua Co.

Skilled Workmen Are Scarce

Good masons, mechanics and carpenters are scarce, and for a big job must be contracted for at increased pay. They earn from $2.50 to $4 per day. These factors must be taken carefully into account, since they influence the cost of the work and increase it over similar work elsewhere in South America.

Bolivia will probably never be a pleasant field of operation, and labor will always be scarce. At the altitude of a mining district, 12,000 to 15,000 ft., the only laborers who can possibly do the work are the natives; that is, it is not possible to import labor from other countries, no matter how rich the mines, so the native popula-

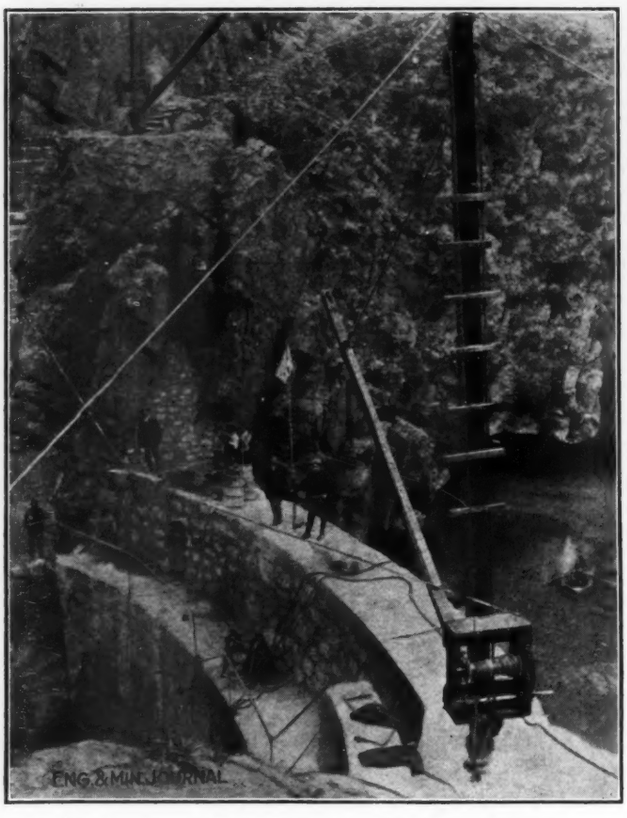
*Manager, Allis-Chalmers Manufacturing Co., Santiago, Chile.

tion is the only one to perform the manual labor. Besides this, the Government is doing its best to exterminate the natives by placing in their hands an unlimited quantity of 40° alcohol. The Indians who are not under the influence of alcohol are stupefied with cocoa.

The unexpected seems to present itself more frequently in Bolivia than elsewhere, and it will suffice to mention the fact that there is an absolute interruption of all communication and transportation with each heavy rain. Another thing which cannot be counted on beforehand is the number of small revolutions and rebellions of the Indian tribes.

Site of the Dam

Fifteen kilometers from the Llallagua mine, the Catavi River runs through a narrow gorge in the mountain for a distance of 500 m., and the narrowest point in this cut makes an almost right-angle bend. At this point the cut is only 2 m. wide for a height of 20 m. From this point it opens out, and at 60 m. the width is 30 m. Further up the gorge widens out to 180 m. The Catavi, Uncía, Zauta and Challanta rivers, together with various branches, run out to this cut. The amount of water varies

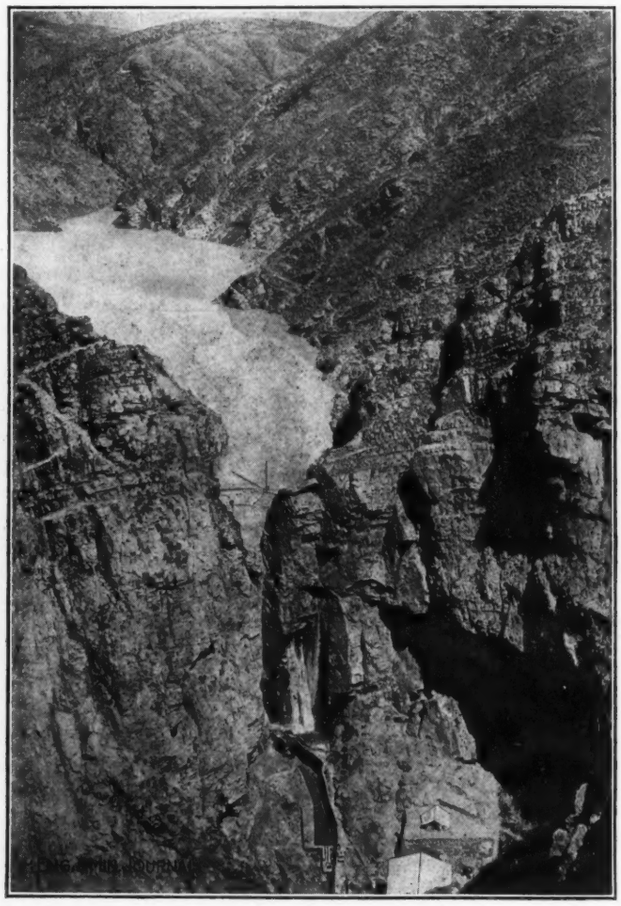


Crest of Dam during Construction

a great deal, and the dry season of the high plateau of Bolivia, which is in November, is succeeded by the heavy rainfalls of the spring, from December to April. In the dry season the total flow of the above rivers does not exceed 200 liters per second, while during the rainy season the flow has reached as much as 70 cu.m. per second. The water is from a shed of 8000 to 10,000 hectares. Several measurements of a rainfall of 20 liters per sq.m. during an hour have been obtained.

This irregular flow makes it necessary to impound all of the water which falls during the rainy season, in order to have a constant supply of power, but the dry-season flow would not be sufficient for requirements. In order to have sufficient fall and water for the turbines during all the year, it was necessary to have a head of at least 30 m., it being figured that an average head of 42 m. would be obtained.

The dam was designed for a height of 58 m., with a waste weir which would maintain a water level of 55 m. during the rainy season. At this level it was estimated



Llallagua Dam and Lake

that enough water would be stored to supply power during the entire year.

The lake so formed is 6500 m. long, with a width which varies between 50 and 300 m., and there is capacity for 18,000,000 to 20,000,000 cu.m. of water. The dam is built *en arco,* both horizontally and vertically. The horizontal arch has a 1-ft. 10-in. versed sine, which was considered advisable for resisting the hydraulic pressure.

Construction of the Dam

The dam is built of cut stone laid in river sand and gravel, hydraulic lime and Alsen cement. The work is reinforced with I- and T-beams, and steel cables at three different levels. The dam foundation is 5 m. below the level of the river and 58 m. above the river at the crest. The base of the dam is 38 m. thick. At 55 m. the dam is three meters thick, with a crown 3 m. high and 1½ m. thick.

The water reaches the turbines through a 65-m. tunnel, through which it flows to a Mannesmann 0.70-m.

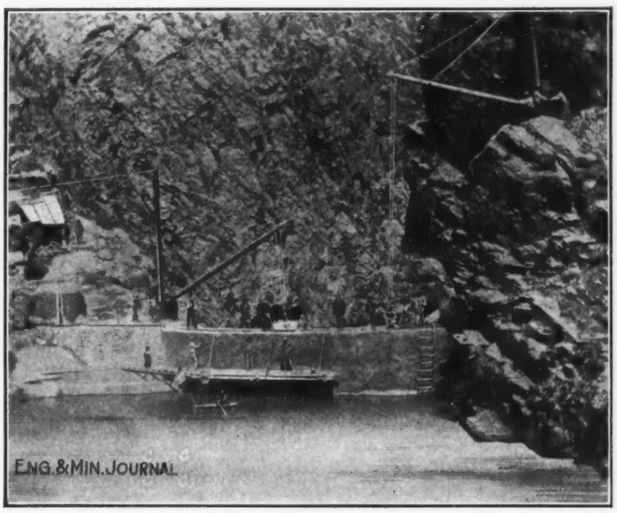
pipe 70 m. long. The turbine house is built for four turbines, direct-connected to their respective generators, of which three are already installed. The turbines are of the horizontal type, built by Escher Wyss & Co. Each turbine passes 180 to 300 liters of water per second, depending upon the water level, and developing 200 to 320 hp. The waste weir is in a depression of a hill, which is at the center of the sharp turn of a river, and located about a kilometer above the dam, discharging to the river bed below the dam.

The generators run 750 r.p.m. and generate a 3000-volt current, which is transformed to 10,000 volts for transmission to the mine. The line loss is 150 volts over the 15 km. The line passes over ground from 3500 to 5000 m. high.

The dam has demonstrated its resistance and strength since completion, having successfully withstood an overflow a meter deep on the crest before the waste channel was completed.

Difficulties of the Work

The work has been particularly difficult due to its great distance from the coast. The railway haul is 900



Llallagua Dam, Upstream Face

km. to Cahllapata, and from there five days' journey in two-wheeled carts to the mine. From the mill there is a day of cart haul to the head of the inclined plain. From the foot of the plain the material was transported on a small Decauville railway to the dam site. The cement was carried from the railway to the works on llamas, and the most of it was lost on the way. The llamas required seven days for the trip, and sometimes were weeks on the way.

It is a curious commentary on human affairs that three years were laboriously spent in building this dam, and it had just begun to furnish cheap power to the Llallagua Tin Mining Co., when the company bumped up against a war and has no market for the tin. Although the United States consumes the majority of the world's tin production, there is no one in America who will buy and smelt tin concentrates. Americans are talking loudly about supplying the needs of South America, but they forget that the first need is a market for nitrates, tin, copper, silver, rubber, cotton, and all the various products of South American countries.

La Sirena, a Wonderful Deposit of Jamesonite

By R. W. Raymond

Economic Geology for July last (Vol. IX, No. 5) contains a paper by Waldemar Lindgren and W. L. Whitehead describing an ore-deposit of exceptional geological interest and commercial value; namely, the body of lead-antimony ore known as "La Sirena," near Zimapan in the State of Hidalgo, Mexico. From that paper, together with reports by H. O. Hofman and R. H. Richards, on the mechanical and metallurgical treatment of the ore, the following account has been condensed, in the hope that it will prove interesting and instructive to the readers of the Engineering and Mining Journal.

This deposit is about 9 miles northeast of Zimapan, on the upper slopes of the lower half of the great Moctezuma cañon. The outcrop appears in the face of a high limestone cliff, and the ore apparently follows the bedding of the limestone, dipping about 40 deg. S. into the mountain mass. It is traceable on its course for 1500 ft., and shows, according to Prof. Lindgren, minimum thickness of 30 ft. through 900 ft. of this distance. At some points more than 100 ft. of thickness has been measured. His very cautious estimates are evidently well within the truth. The extent of the body on the dip has not been determined—as it could not be, without explorations, which, on account of the present disturbed political condition of Mexico, have not yet been made.

Professor Lindgren, one of the most acute observers and logical reasoners in the study of ore-deposits, recognizes this case as clearly one of replacement, yet pronounces it to be of "a most unusual type." Its exceptional features may be appreciated through a careful study of his detailed description of its mineralogical character.

The Cretaceous limestone in which it occupies a horizon not more than 2500 ft. below the Cretaceous plateau of the Sierra Madre Oriental is traversed near the eastern end of the deposit by a dike of basic rock (dark gray, jointed, and partially iron-stained porphyry), through which, probably, the metasomatic mineralization took place. But the products of ordinary metamorphism (the recrystallization of minerals, etc.) are confined to the interior and the neighborhood of this dike. The great ore-body itself is not the result of contact-metamorphism, but of replacement facilitated by the shear-zone of the dike. The authors of the paper express their belief "that a vast amount of calcium carbonate has been carried away, but that, volume for volume, this calcite has been replaced metasomatically by minerals deposited from solutions carrying silica, alumina, sodium, boron, fluorine, phosphorus, arsenic, sulphur, iron, zinc, lead and antimony." Of these, the nonmetallic solutions, depositing danburite, garnet, albite and quartz, are believed to have been the earliest, and to have been followed, after no great interval, by solutions of magmatic origin, which deposited pyrrhotite in the still hot dike-mass, and other metallic sulphides in the cooler replacement mass within the limestone.

The metallic ore-minerals (all, probably, later than the gangue-minerals) are, in the order of their formation, arsenopyrite, pyrrhotite, blende and jamesonite ($2PbS, Sb_2S_2$), a sulphide of lead and antimony.

The most peculiar feature of the deposit is its evident

formation at very high temperature. Without quoting in detail the argument establishing this conclusion from the paragenesis of certain minerals (especially the actinolite, which is practically contemporaneous with the jamesonite), we may accept the statement that "there is strong ground for believing that the deposit was found at between 400 and 550° C.," and thus, in the opinion of the authors, "presents a most important link between contact-metamorphic and hydrothermal replacement deposits," having some of the features of both, but not all the features of either.

At present, this occurrence possesses, perhaps, a greater economic than scientific interest. For the world-war has already revolutionized trade in antimony. During the last few weeks, this country has figured perhaps for the first time as an exporter of antimony to Europe, although it is an importer in ordinary times of about twenty million pounds annually. The usual sources of supply are Oriental, and have become seriously uncertain.

The price has risen from about 7c. in July last to about 14c. at the end of November. During the Russo-Japanese war, it reached 27c., and remained at that figure for a considerable period after the declaration of peace. This time, its probable scarcity and consequent rise in price will be enhanced by a large demand for the metal as an ingredient of the alloy used for many sorts of projectiles. A recent circular of the Marlin Fire Arms Co., of New Haven, Conn., gives from 7 to 15% of antimony, from 7 to 10% tin and from 75 to 86% lead as the range of composition for bullets to be used in smokeless-powder, high-velocity cartridges. Modern shrapnel for field-artillery contains about 12.5% of antimony, and consists of spherical slugs, 2 oz. in weight, of which each shell carries from 250 to 300. Every shell thus discharged throws away about 70 oz. of antimony.

The accounts in every day's newspaper of furious artillery fighting along hundreds of miles of firing line are enough to show how great is this sudden demand for antimony, and to warrant the apprehension of famine prices entertained by many industrial consumers.

This situation renders the description of La Sirena almost sensational. For it presents, *prima facie,* the appearance of an enormous body of antimonial-lead ore, so formed and located as to be cheaply mined on a large scale and so constituted mineralogically as to be capable of profitable reduction by known methods. To state, in outline only, the elements of economic value which make up this *prima facie* case:

(1) The size of the deposit is probably even greater than is indicated by the face exposed. At all events, a little development work will make that matter clear.

(2) The quality of the ore is estimated by Professor Lindgren, upon samples taken by himself, as "at least 8% of lead and 4% of antimony." Other samplings at the same places have given similar results; but still others, taken at points not accessible to him, indicate a much higher average. It is safe, therefore, to accept his figures as a minimum average. In any event, they are high enough for profit, provided the ore can be successfully reduced on a large scale.

(3) Here the evidence of Professors Hofman and Richards seems to be conclusive. They have found that the Dwight-Lloyd blast-roasting and sintering process is peculiarly effective in separating lead and antimony with minimum loss of metals. Apparently the presence of these metals combined in the single mineral, jamesonite, is more favorable to such a treatment than their occurrence separately as galena and stibnite. If the ore as mined is not rich enough for direct roasting, it can be concentrated, by methods which Professors Hofman and Richards have proved in the laboratory, to a product containing not less than 25% of lead and 15% of antimony.

This product, or crushed crude ore of sufficient richness, can be treated on the Dwight-Lloyd machines, volatilizing the antimony and arsenic as oxides (to be recovered in dust-chambers), expelling the sulphur to a satisfactory degree, and leaving a sinter high in lead, low in sulphur, arsenic and antimony, and highly suitable for smelting in the blast furnace with siliceous and pyritiferous silver ores and silver-lead ores, such as are produced in the neighboring districts.

The metallurgical proposition seems to be entirely reasonable and feasible. Of course, all the conditions now indicated will have to be verified on a larger scale, and the exploitation of the immense orebody by modern cheap methods will require a large expenditure on mining and transportation, as well as metallurgical plant. But capitalists are not afraid to make large investments in really great mines.

There is but one unfavorable feature in the case: the political condition of Mexico. So long as all the military factions in that country find so much enjoyment in fighting and plundering, and our government takes so much pains not to protect the interests of Americans in Mexico, the song of La Sirena might prove a deceitful lure. But matters in Mexico have now come in every way to such a pass that, since they cannot well become worse, they must soon mend or be mended. Under any government that maintained order and encouraged industry, this immense and unique ore-deposit would be developed quickly into a source of new wealth for Mexico and the world.

Liability for Accident to Miner

By A. L. H. Street*

In a suit for damages for death of a miner who was killed by a fall of rock while at work in a finished chamber, the California Supreme Court lately held that a miner is under no legal duty to make any more extensive inspection of his place of work, to determine its safety, than would be exercised by an ordinarily prudent miner in the same circumstances; that a miner at work in a finished chamber need not exercise the high degree of care to avoid falling rock that is required in driving a new shaft; and that $20,000 was not excessive recovery in this case for the benefit of a surviving widow and four children, it appearing that decedent was only 33 years old and was earning $3.50 per day. (Grabbe vs. Mammoth Channel Gold Mining Co., 143 *Pacific Reporter* 714.)

From Stavanger, Norway, is Reported the Discovery of Hematite Iron Ore of excellent quality. The discovery comprises three lodes of considerable width, running parallel with each other. The deposits are situated at Lund, in the parish of Dalene, and close to a railway station. According to the "Iron and Coal Trades' Review," they have been examined by a mining expert, who has given a favorable report on them. In several analyses of the ore the iron content varied between 62 and 67%. It is understood that an English company had an option for the purchase of the deposits, and was about to start trial work to ascertain their extent, but operations were postponed on account of the war.

*Attorney, St. Paul, Minn.

Quartz Veins in Lamprophyre Intrusions

By John F. McLennan*

SYNOPSIS—Quartz veins occurring in lamprophyre dikes, especially minette dikes, in granitic rocks, are often gold- or silver-bearing to a limited depth; i.e., within a "reconstructed" zone enriched by downward concentration. Experience shows that while the ore within the altered zone can be profitably mined under conditions favorable for mining, all attempts to find ore at greater depth have proved futile.

In the Sierra Nevada Mountains and the interior Cordilleran region of North America, and likewise in many foreign places, there are numerous examples of gold-quartz veins following lamprophyre dikes or sills in granitic rocks. This class of ore deposit has, as far as I am aware, received little attention from writers on economic geology.

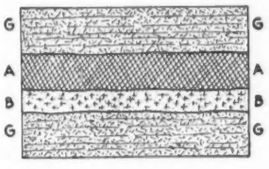


Fig. 1. Ideal Section of a Lamprophyre Controlled Vein

A, quartz vein; B, lamprophyre dike foot wall; G, sheeted or schistoid granite.

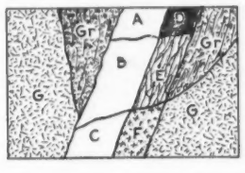


Fig. 2. Ideal Cross-Section of a Lamprophyre Controlled Vein

A, upper portion of reconstructed part of vein further enriched by downward concentration; B, lower portion of reconstructed part of vein; C, primary filling without value; D, kaolinized portion of lamprophyre dike forming foot wall; E, sericitized portion of dike; F, unaltered portion of dike; Gr, altered schistoid granite; G, normal granite.

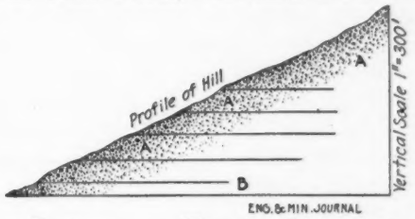


Fig. 3. Longitudinal Section, Golden Jubilee Vein

A, important orebodies; B, primary conditions, quartz without value.

Consequently the engineer in quest of information on this subject searches mining literature in vain. This article in its treatment of the vein system in consideration deals particularly with California phases, as being representative of the type.

As is characteristic of similar regions in other parts of the world, large tracts of the granite areas of the Sierra Nevadas and adjacent mountain ranges in process of cooling and solidifying by crystallization of the outer portions of the magma were subjected to internal stresses, and, under force of increasing contraction, numerous joint planes, and even rents of much regularity and persistence in length, resulted. The fractures thus developed extended only in minor part to great depth. However, particular instances exist evidencing deeper trends, reaching to submagmas dissimilar in composition to the overlying rock. Into the stronger and more easily accessible fissures, pressure forced up the still liquid material, producing dikes and sills ranging from a few inches to many feet in width. The submagmas, or liquid inclusions, were strongly ferro-magnesian, and the resulting dikes chiefly the lamprophyre, minette. The aplitic intrusions are not referred to, as they do not have direct bearing upon the subject in consideration in this discussion.

*Mining engineer, 865 Monadnock Bldg., San Francisco, Calif.

From facts demonstrated by exploration, as well as through study of the general phenomena governing the conditions, it is particularly evident that the fissuring action was wholly crustal in nature, and that even the source of the lamprophyre was not, at the time of ejection, lying at remote depths. In fact, a measure of caution is necessary in order not to confound or class this action with the great dynamic forces that gave inception to the profound fault fissures that in the succession of time received their contents from abysmal depth.

Quartz Veins with Lamprophyre Foot Wall

Following many of the lamprophyre dikes or sills and occurring in direct conformity therewith are quartz veins varying in thickness and continuity. In general, these veins along their dip rest on the upper side of the dikes; in other words, the dikes form their foot walls. Genetically, the source of the vein-forming materials is assigned to the magma, which in process of cooling and condensation expelled aqueous solutions charged with silicic acid, together with minute quantities of the metallic compounds distributed in the congealing mass. With the dense lamprophyre acting as a barrier to the further advance of the solutions, stagnation, followed by deposition of vein quartz, took place, the magnitude of the deposits being commensurate with the degree of enlargement of the spaces formed by the progressive shrinkage of the dikes, and also of the region bordering the dikes.

The vertical distance reached by the magmatic waters which deposited the quartz in these veins is not in general, according to evidence, remarkably great. I have on frequent occasions in mine workings observed its total disappearance, either by absorption into the dike or the blending below of the dike rock with the granite mass, or quite commonly by a gradual reduction to pegmatite; and again conditions exist where the quartz continues indefinitely, but only as a barren glassy mass coalesced to its surroundings, and devoid to any determinable extent of metallic minerals.

Post-Enlargement of Veins Resulting through Chemical Action

The granites usually inclosing the lamprophyre dikes and quartz veins range from rock with orthoclase predom-

inating to varieties with plagioclase in excess, there being a like range of the mica, hornblende and pyroxene minerals. Adjacent to the veins, and frequently for considerable distances outward, the granite, as well as the dike rock, has undergone a strong degree of sericitization, followed by weathering, but with marked alteration not, however, extending to great depth, the weathering in particular being limited to a vertical range of a few feet, rarely to a depth exceeding 200 ft. In the process of chemical change, the lamprophyre underlying the veins was deeply altered, with the abstraction of silica, to varying but limited depth, the alteration product usually consisting of a white or gray to yellowish or brownish clayey to sericitic matter with the dikes again gradually assuming normal condition as a certain point is passed. Less frequently, conditions obtain where the underlying dikes still retain their original structural features though metamorphosed and leached, or even when softened. The neighboring granite inclosing the veins also suffered a loss of silica. The siliceous solutions thus developed gathered and brought with them in concentrated form, as it were, much of the gold and various metallic minerals infinitesimally distributed in their path, and invading the practically barren quartz veins caused a complete change in texture and mineralization, or a transformation from a compact glassy mass to a more or less waxy and sometimes cellular quartz of diversified crystallization carrying commercially important quantities of gold. But the conditions that permitted the deposition of the metallic contents and the change through accretion of new gangue-forming material from without, were effective only in the zone of alteration; at a limited distance below the surface, or beyond the range of chemical action, the barren vein matter is certain to be reached, without even a remote hope of finding a restoration of the valuable metal. In veins or parts of veins where the upper portions have not undergone reconstruction, the same textural and valueless fractures obtain as in lower horizons. An additional fact of importance, apparent in the very uppermost portions of the veins, consists of a subsequent further enrichment, through successive downward concentration within the veins themselves, from parts later eroded away.

Distinctive Characteristics of the Lamprophyre Controlled Veins

A distinguishing feature of this type of gold veins is, in part, their affinity for granitic rocks, either biotite-granite or grano-diorite, and less frequently quartz-diorite. But their chief distinction rests upon their persistent association with the lamprophyre, minette. As hereinbefore stated, the dike-controlled veins may stand at any angular position, even to perpendicular; on the other hand, the minor sheets of quartz following sills are low in dip, and at times are found lying nearly horizontal. The latter, however, on account of their usual extreme thinness, are seldom of economic importance.

In the region next the veins, the granite, in addition to chemical alteration, usually shows ill-defined schistosity and some decay. The minette dike-rock underlying the veins, though at times still retaining its structure in the presence of metamorphism of a strong degree, is usually completely decomposed to a kaolinized product for several feet in depth. At this stage the quartz veins are commonly strong and the gold content in many instances is of good tenor. Further exploration of the deposit shows the inclosing granite to be growing more compact and the kaolinized portion of the dike rock to have passed into a sericitic aggregate or developed into soft rock of schistose structure, with gold yet persisting, however. Still continuing to increased depth, it is discovered that both the granite and dike rock have attained a fairly normal condition, and that the vein-filling has become glassy and bound to the inclosing rock or has changed into pegmatite, or perhaps it has wholly disappeared by fading into the dike, or the dike has blended with the granite, obliterating the channel. In either event, here the wise man stops and sets out for a new venture. The other fellow, however, is keen on depth and drifts and crosscuts—he does not understand.

Mineralogy of the Deposits

The minerals accompanying the gold in the lamprophyre-controlled veins are often quite diversified. In the region north of the Tehachipi Mountains, the gold is frequently associated to varying extent with iron and copper oxides, pyrite, chalcopyrite, galena and sphalerite, and sometimes subordinate quantities of tellurides and their oxidized products, with the tellurium minerals when present giving much trouble in recovery of their gold contents. In the desert regions of southern California, where similar veins occur, silver is often a predominant constituent of the ore and frequently exceeds the gold contents in value.

Citations Illustrative of This Vein Type

Golden Jubilee—This mine, near Carville, Trinity County, Calif., conforms to a minette dike in grano-diorite. The vein in its course climbs a steep hillside and is opened by five tunnels at vertical intervals of 100 ft. Strong alteration follows the vein along the slope of the hill, reaching its greatest depth, which is approximately 200 ft., at the crown, and decreasing as the hill descends. The position of the altered zone is such that it was penetrated by all of the tunnels in their passage to the points hundreds of feet beyond. A phenomenon of large import, is the suddenness with which the gold disappears as the border line of the unaltered or primary conditions is reached. The upper or altered portion of the vein has in time past produced gold to the value of $200,000, with the likelihood at a future period of a further recovery of a like sum, from partly developed ore reserves still existing within the same source. The underlying unaltered territory conformable to the zone of alteration, although extensively explored, reveals nothing but bodies of uninviting massive quartz, devoid of value.

Dewey Mine—In the same grano-diorite area as the Golden Jubilee and three miles from that property is the Dewey mine, representing a certain phase of the type. The surface is deeply altered, and from the altered region some high-grade gold ore was extracted. Later a crosscut tunnel was driven, which passed through a minette dike 12 ft. wide. The vein was found on the other side of the dike, and drifts 8 ft. high were driven to the right and left on the curve of the vein. The top of the drifts shows 4 ft. of quartz, containing gold; at the bottom of the drifts the quartz is rapidly disappearing, with only a few barren stringers passing downward into an underlying schistose portion of the dike.

Granite Basin Mines—Granite Basin lies in the high

Sierras of Plumas County, Calif. The country consists of biotite-granite, grano-diorite and smaller areas of quartz-diorite. Both minette and mica-diorite dikes intrude the granitic rocks. Along these dikes occur quartz veins, which, while in the zone of alteration, yielded profitable gold ore. But the greater number of these veins before attaining depths exceeding 100 ft. petered out. A few of the stronger ones lingered slightly beyond this depth; but they, too, failed. Much foolish work followed, with frequent recurrence of fresh enthusiasm. Various occurrences similar to Granite Basin are found in the adjoining county, Butte.

Mother Lode Counties—In many parts of the Mother Lode counties, though never in the Mother Lode belt, and usually lying at great distances away, lamprophyre-controlled veins characteristic of the discussed type occur in granite. There is, however, another system of veins in this region occurring in granitic rock that cannot be included under this heading, and being widely at variance with the subject in hand is not in consideration here.

Mud Springs Mine—This mine, in Madera County, Calif., illustrates a particular phase of the lamprophyre-controlled veins. The country is hornblende-biotite granite. The granite has been intruded by a wide dike of minette, and the vein is found overlying and conformable to the dike, which dips at 35°. In proximity to the vein the granite is schistose and some movement is apparent, due to creeping. Both the granite and minette have undergone strong alterations, but, contrary to the greater number of lamprophyre-controlled veins, the upper part of the dike shows little kaolinization, and retains its structure, though soft and crumbly. An orebody was discovered near the surface, and continued along the dip in conformity to the zone of alteration for a distance of approximately 250 ft. The ore consisted of a semiwaxy quartz containing sparing disseminations of galena, and for a considerable period averaged $60 per ton in gold. The total production from this orebody is estimated in round numbers at $500,000. A long drift driven in the inadequately altered territory underlying the location of the oreshoot shows complete impoverishment, while further exploration by a winze sunk from the drift a distance of 80 ft. shows that the texture of the quartz is gradually changing, finally passing into true pegmatite.

Abbey Mine—At a distance of two miles from the Mud Springs is the Abbey mine, having many of the former's characteristics, yet differing in others. Here the intrusive consists of a wide dike of kersantite, along which marked faulting movement occurred. A long shoot of ore discovered at the surface continued down the plane of the vein, which dips at a low angle, to a distance of 400 ft., and produced, according to information from reliable sources, a total of $1,400,000 in gold. Upon the exhaustion of the orebody, further exploration was carried on in hope of making new discoveries, but nothing of value was found—the conditions had changed.

Other California Regions

Veins of this type occur in Fresno and Tulare Counties, and in many instances in Kern County, particularly in the Tehachipi Mountains, where they exist in wide distribution, following either dikes or sills, but are without downward persistence, and of the class that pass beyond recognition. Likewise in the ranges of the desert region, veins of the type are found in great number, though many of the desert occurrences may predominate in silver content.

Types akin to those described occur in many sections of Nevada, for example, the Colorado River region, where they are found adjoining lamprophyre dikes and sills in pre-Cambrian gneissoid granite, with values usually good as far downward as characteristic alteration extends. Likewise in Mohave County, Arizona, and other parts of that state, both silver and gold veins follow lamprophyre intrusions in either gneiss or granite. In Idaho a similar type occurs, though unlike in morphologic features. With differing variations, the type is also found in many places in the region of the Rocky Mountains. Some of the conclusions embodied in this article may be new; yet they are the result of years of varied investigation and close study.

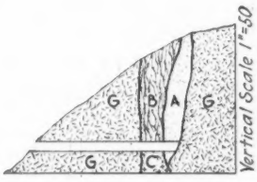


Fig. 4. Cross-Section of Dewey Vein

A, orebody; B, sericitized portion of lamprophyre dike; C, unaltered portion of dike coalescing with granite; G, granite.

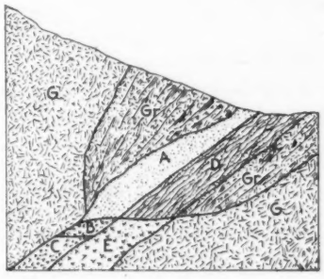


Fig. 5. Cross-Section of Mud Springs Vein

A, reconstructed orebody; B, intermediate between quartz and pegmatite; C, pegmatite; D, sericitized blocky lamprophyre; E, unaltered lamprophyre; Gr, altered schistoid granite; G, granite.

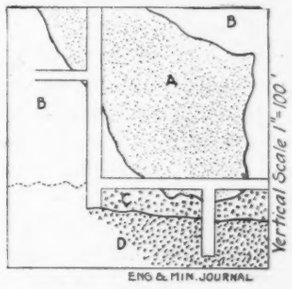


Fig. 6. Longitudinal Section of Mud Springs Vein

A, reconstructed orebody; C, intermediate between quartz and pegmatite; D, pegmatite; B, thin sheet of quartz without commercial value.

The Relative Thermal Conductivities of Refractory Brick were tested by G. H. Brown ("Trans. Am. Ceram. Soc." 1914, p. 382; abstr. "Journ. Soc. Chem. Ind."). The composition of the three sample bricks tested was: Silica brick: SiO_2 95.48, Al_2O_3 1.92, Fe_2O_3 1.42, %; quartzite brick: SiO_2 83.36, Al_2O_3 11.79, Fe_2O_3 1.69, %; clay brick: SiO_2 63.24, Al_2O_3 32.97, Fe_2O_3 1.33, %. Readings were taken up to 1300° C. The relative thermal conductivities of the bodies, silica, quartzite and clay, were found to be as 1017:986:933, silica brick thus having a conductivity 9.0% and quartzite 5.7% greater than that of clay. The conductivity of either magnesite or chrome brick of course considerably exceeds that of silica brick.

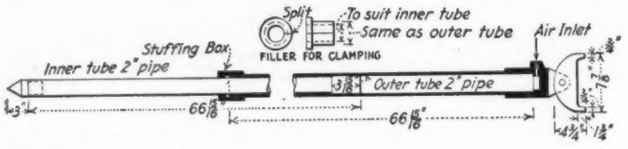
Details of Practical Mining

Pneumatic Drill-Column

By Sven V. Bergh*

An important factor to be considered in getting the highest efficiency out of the modern hammer-drill is the simplification of the drill mounting when such mounting is required. The labor cost, compared with the other costs of operation, is in most cases predominant, and it must be borne in mind that, roughly estimated, only 40 to 50% of the total shift can be used for actual drilling, the rest being absorbed in setting up and other manipulation of the machine.

When a column or bar has to be used the drill may be either attached to it directly or it may be carried on an arm; the column itself may be of either the single-screw or the double-screw type. In any case, its height is adjustable to only a limited extent. Hence, to make a set-up in the best position for the round of holes to be drilled, the workman has to use a good deal of skill and do considerable planning; in most cases a lot of time is wasted in mucking, arranging blocking, picking down back or picking up bottom, in order to get good bearing surfaces for the column.



Compressed-Air Telescopic Mounting for Light Drill

To facilitate these operations, a pneumatic drill-column was devised and has been used with good results for several years at the iron mines of Malmberget, Sweden. It resembles in general the telescopic air-feed of the stoper type of drill. A longitudinal section is shown herewith. The height of this particular column can be varied between 6.23 and 11.48 ft. When the column is fully run out, the compressed air is shut off by means of an automatic cutoff valve. There is no need of the usual arm in order to provide a sufficiently wide range of positions for the machine. The column, drill and all are easily removed from one position to another as required, and the absence of an arm makes this all the easier. The drill-clamp is adjustable with one single screw-bolt, and is made with a hinge so that the machine can be swung over to one side, when the drill steel has to be changed. The clamp is attached to the outer tube. This has a toothed foot-piece which bears on the bottom and resists rotation. The inner tube ends in a point which bears against the back. It is, of course, not subject to any torsion.

The column was found sufficiently stable when the regular drilling pressure was used, but is adapted only to light hammer drills of the stoper type with telescopic air feed and for drilling in soft to medium-hard rock.

It should be noted that when air is turned off, the machine first stops drilling and the air in the column maintains static pressure for some time. It can, however, be exhausted rapidly if desired.

*Mining engineer, Chrome, N. J.

Errors in Surveying

Cumulative errors should always be recognized as such and carefully avoided, says A. W. Bedell in *Engineering News*. Personal errors are often of this kind. To illustrate, the vibration of a plumb-bob string will be compensating, but if a chainman habitually stands so that his eye will project the point of the bob to the ground obliquely, the error from this will be cumulative.

If a chain is out of alignment by an amount d in a length l, the error in distance from this will be approximately

$$e = \frac{d^2}{2\,l}$$

This error is of little importance on long tapes, but it is cumulative. It is also worth while to notice that a transit should be centered more carefully in one direction than in another.

Often it is required to know what error of closure is to be expected, consistent with the accuracy of the work done. The usual way of designating errors of closure, as 1 : 3000, etc., is misleading, for the degree of error does not bear a constant relation to the distance. The same accuracy of work which would produce an error of 1 ft. in 3000 ft. would result in an error of only $\sqrt{2}$ ft. in measuring 6000 ft. Since most errors vary with the square root of the distance and since areas vary with the square of the distance, the absolute closing error may be expected to increase only with the fourth root of the area. But if the work includes many cumulative errors, it will vary more nearly with the square root of the area.

If the angular error in a single course be represented by a, resulting in a distance error of y at the end of the course, and if x be the error in linear measurement, the resultant of these is the error of closure e. If the course were long enough to continue around the traverse and close upon itself, the total value of e would be the error of closure of the survey. If the probable angular error in feet per 100 ft. be taken as y_1, the probable linear error per 100 ft. as x_1, the average length of a course in 100-ft. units as n, the number of courses as m, and the total traverse in 100-ft. units as l, equal to mn, then for the whole survey

$$y = n y_1 \sqrt{m}$$

$$x = x_1 \sqrt{mn}$$

and the error of closure

$$e = \sqrt{x^2 + y^2} = \sqrt{l n y_1^2 + l x_1^2}$$

On a transit reading to minutes y_1 will be about 0.01 or 0.02, and according to the skill of the chainman, x_1

will be between 0.01 and 0.1. It will be noticed from the first equation that by increasing the number of courses, the error y will somewhat decrease relatively, for it accumulates on a single course, and it is partially compensated as the number of courses is increased—within limits. This formula is applicable only for compensating errors.

When a measurement is made to the nearest unit of any kind, and made accurately, the probable error from this source of a single reading is not one division, but a quarter of one division. The greatest error possible would be half a division, and the mean of all errors from zero to a half would be a quarter division. Using large units, therefore, is not inconsistent with accuracy, providing instrumental errors are small.

It may easily be demonstrated that leveling can be done by reading the rod only to tenths, giving, with 25 sights to the mile, an error of ¼ of $0.1 \times \sqrt{25} = 1\frac{1}{4}$ tenths. It may be added that for many purposes it is well to use larger divisions, as tenths of feet on rods and chains, and to subdivide these to hundredths of feet by estimation with the eye only. Those who have never tried this method will be surprised at the accuracy with which work can be done. The average surveyor with ordinary practice can subdivide a unit into tenths with a mean error of about half a tenth or less. The absence of many small graduations is certainly less confusing.

Smoothing Out Old Drawings

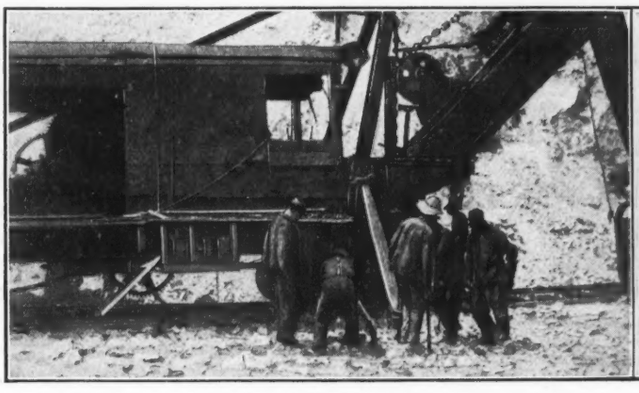
When it is desired to flatten out old mounted plans, old paper drawings or old cloth or paper prints, says *Engineering News,* the following method has been found to work successfully in every instance where harsh handling or reverse rolling would ruin the appearance of a drawing: Make a thick, boiled starch of flour by boiling flour and water down to almost the consistency of thin dough. Lay the plan out bottom up on a flat surface and apply the starch as a paint, thoroughly rubbing it into the surface. Keep the plan perfectly flat until dry and then it will be found that it will remain smooth. The flour starch will not injure the plan in any manner.

A Detector for Dangerous Ground is noted in the "Queensland Government Mining Journal." It consists of a telescope rod to which is attached a dry-cell battery, a bell and a red light. Rock movement or pressure is transmitted so as to ring the bell and cause the light to glow. The device can be set to any desired degree of sensitiveness.

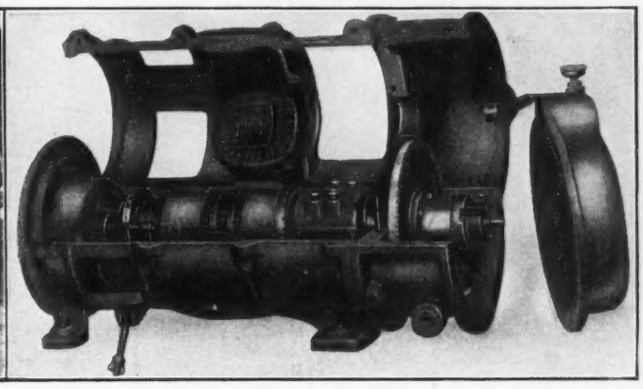
Steam-Shovel Electric-Lighting Set*

For steam-shovel night work adequate illumination is imperative, not only on the bank from which the shovel digs but also around the shovels themselves to permit the necessary inspections and adjustments and to afford safety for the workmen.

At the Utah Copper acetylene had been tried for this work, but proved troublesome, costly and somewhat dangerous, so electrical illumination was adopted. The general illumination of the bank is furnished by a battery of powerful projector searchlights on the opposite side of the cañon from that on which the shovels dig. To supply local illumination, about 20 incandescent lights were placed on each shovel, but it proved a problem to get current to them. One difficulty lay in the fact that shovels must move at short intervals. A method was devised of mounting a reel on each shovel, to carry a semiflexible cable which was unwound on the ground as the shovel proceeded. One end of this cable was tapped to a power circuit carried on poles. This arrangement gave considerable trouble during the several years it was in operation. Rocks rolling from one terrace to another would carry away wires or poles and blasts would frequently throw rock which damaged the cables.



THE GENERATING SET IN PLACE ON THE SHOVEL



THE UNIT WITH CASING OPENED

In December, 1913, the Westinghouse Electric & Mfg. Co. furnished the Utah Copper Co. for trial a 1-kw. general-utility turbo-generator outfit. This set was fastened to the under side of one of the shovel frames as shown in the illustration and was supplied with steam from the shovel boiler.

This shovel made so good a record that the company purchased the turbo outfit furnished on trial and later ordered six more, which are now being installed.

One set will operate an arc lamp and a few incandescents at the same time or about forty 25-watt incandescents alone. Practically no attention is required for the set because it is designed to operate for long periods without care. There are no delicate adjustments to make and every part is accessible for inspection.

Full rating is developed on steam pressures between 90 and 250 lb. A governor controls the speed and keeps it uniform. A fixed resistance furnishes voltage regulation and a rheostat is provided to adjust the voltage when

*From information furnished by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Penn.

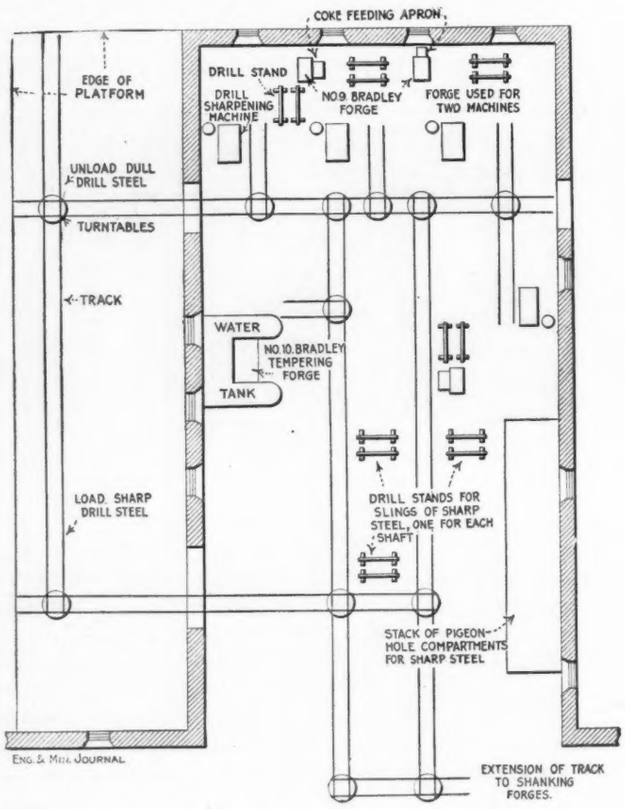
the number of lamps in use is varied. Hence, in spite of the abrupt changes in steam pressure and load that characterize shovel service, steady light is obtained.

Handling Drill Steel at the Quincy Mine

By L. Hall Goodwin*

The method of handling drill steel at the Quincy mine, Hancock, Mich., is different from that usually employed at the larger mines of the Lake Superior district, where the problem is to sharpen the steel for several widely separated shafts at a centrally located shop. The method used by the Copper Range Consolidated Co. has been fully described in this department of the Journal[1]; and the Calumet & Hecla system does not differ essentially from that used by the Copper Range, that is, the drills are kept loose and are carried to and from the various shafts in steel boxes, each shaft having its special box.

The main distinguishing feature of Quincy practice



Layout of the Quincy Drill-Sharpening Shop

is that the steels are kept in slings, each sling containing eight to 10 drills, which are assigned to a certain contract. Dull steels are put up in slings at the working place underground, and sharp ones before they leave the drill shop. The sling consists of a piece of ½-in. flat iron, 1½ in. wide, formed into a ring having an inside diameter of 4 in. The steels are held in this ring by means of three wooden wedges, 8 in. long, placed side by side, the middle one being reversed end for end with respect to the other two, and hammered into place; this forms a firm bundle of convenient size for handling.

All miners have a "contract" number, although only those employed in mine development actually work on contract; for other miners, the number is used only in distributing tools and supplies. Each piece of drill steel is assigned to a certain contract, and the number of that contract is cut on its shank.

Dull drill steels are sent to surface and sharp ones sent underground after each shift has gone off. The dull steels are carried to the shaft by the miners and dropped where they can be easily loaded into the south skip, as it has become an arbitrary rule at this mine always to use the south skip for handling tools and supplies. When all men are up, the man-cars are immediately replaced by skips, and the first skip hoisted in the south road picks up the slings of dull steel from all the levels; the sharp drills are sent down on the next trip of the same skip.

At surface, the skip automatically discharges its load of dull steel at a special dump just above the collar of the shaft. They pass into a concrete chute, the bottom of which is faced with old rails, flange up. This chute starts off at 30°, but its inclination gradually changes to horizontal and it then forms a platform at a convenient height for loading on a wagon. Dull drills are collected and sharp ones distributed by one of the surface teams. The slings of sharp steel are stood up in a row of racks along the south side of the shafthouse, the racks being numbered corresponding to the working levels.

The accompanying sketch shows a plan of the drill shop. It will be largely self-explanatory after it is stated that the drills are transported from one part of the shop to another on flat-topped cars having rigid trucks which necessitate straight tracks and turntables. An extension of the track, as shown, reaches four hand forges used in shanking the steel. The drill sharpeners used are a modified form of the Word machine. Drill stands consist of two wooden horses, their tops faced with a 3-in. strap of ½-in. iron, set at a convenient distance apart. The tops of the cars are 36x48 in., and four iron stakes fit into tenons at each corner.

The sharp steel is sorted by boys in front of a stack of pigeon-hole compartments, drills belonging to each contract being kept in a separate compartment. The pigeon holes are numbered in order by contracts, and the shaft and level numbers are also given. The sharpened drills are removed from the pigeon holes by other boys, who bundle them into slings; the slings going to each shaft are segregated on one drill stand, the shaft number being marked with white chalk on the ring, the contract number with blue chalk on the wedges. The slings are left on the drill stands until a truck load of them has accumulated; they are then wheeled out to the loading platform.

As compared with the practice of the other Lake mines, the Quincy system has the marked disadvantage that the drills are handled a greater number of times by hand than is usual; this disadvantage is largely offset by the drills being in bundles. The principal advantages of the method may be stated as follows: All sorting is done in the drill shop, where it may be easily supervised; drills for each contract are in rigid bundles, which fact tends to secure better distribution of them; the drill steel is easily handled while being distributed to the underground working places; this latter point is of especial force in minimizing delays to the hoisting plant, which is an important factor at these deep, low-grade mines.

*Mining engineer, 3 Barstow St., Allston Station, Boston, Mass.

[1]"Eng. and Min. Journ.," May 4, 1912, p. 881.

Details of Milling and Smelting

Precipitating Plant at the Copper Queen Mines

By Charles M. Coats and Glen L. Allen*

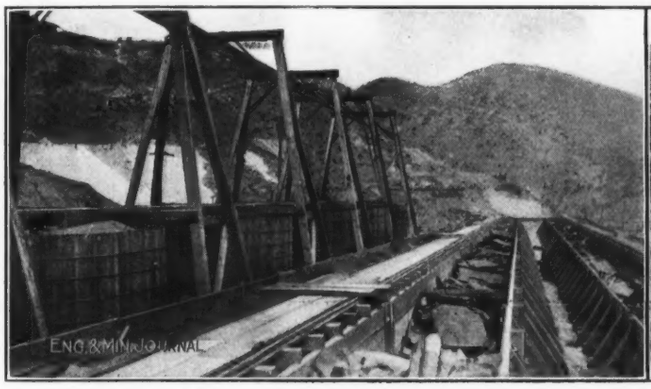
The Copper Queen Consolidated Mining Co. recently placed in operation its new flume-type scrap-iron precipitating plant at Lowell, Ariz., in the Bisbee-Warren mining district. Construction began early in October, 1913, under a 60-day contract with all material furnished to the contractor. Mine water was turned into the plant in February.

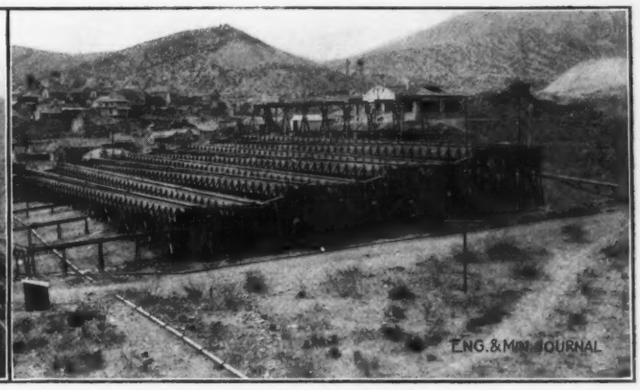
The plant covers about 2.6 acres on a gentle slope and, in general, enjoys in its operation all the advantages of a hillside location. The mine water which is pumped from the Czar shaft flows through a 3600-ft. flume and at the plant enters a series of six large tanks, containing heavy scrap, thence into eight sets of flumes containing lighter scrap. The barren water then flows into a settling tank; a portion of this water is then pumped back to the mines and the remainder allowed to go to waste. The general layout of the plant is shown in an accompanying illustration.

The flume leading water to the plant is of the ordinary open-box type with a 10x24-in. rectangular cross-section and constructed of 12x12-in. planks 16 ft. long. It is supported by simple wooden bents where necessary to maintain a uniform grade of 0.4%. The last 560 ft. of the flume consists of a continuous-stave, 14-in. redwood pipe, which takes the form of an inverted siphon to carry the water under a railroad track.

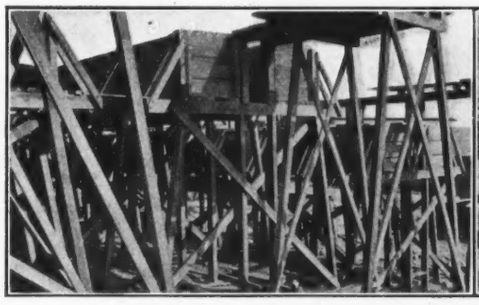
In order to utilize many heavy pieces of scrap iron which the company had on hand, the management decided to employ the six large redwood tanks mentioned above as the first unit of the plant. These tanks are 20 ft. in diameter, 10 ft. deep, with a fall between tanks of 0.4%. They are so connected with the launder that the water may be cut off from any one or all of the tanks while the cement copper is being flushed from under the heavy false-bottom grating which keeps the scrap off the bottom of the tank. Each tank is provided with a sloping floor and two especially designed doors near the bottom. These doors facilitate the removal of the cement copper, which is flushed from the tanks into launders leading to the settling tanks.

The second unit of the plant consists of a series of eight double parallel flumes with small connecting launders at the end of each flume. Each double flume is 250 ft. long, 4 ft. wide, 45 in. deep, has a uniform slope of 1%, and is supported upon wooden bents. The sides are built of 2-in. by 12-ft. planks, bottom of 3-in. by 12-ft. planks,

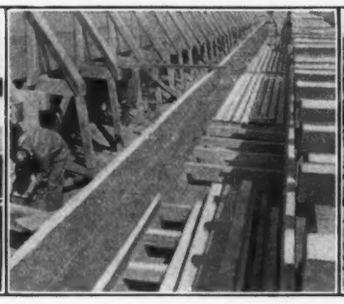




Copper Queen Precipitation Plant, Douglas, Ariz.
Upper tier of round tanks. General view of plant.



Precipitating Tanks under Construction



Precipitating Tanks, Showing False Bottoms

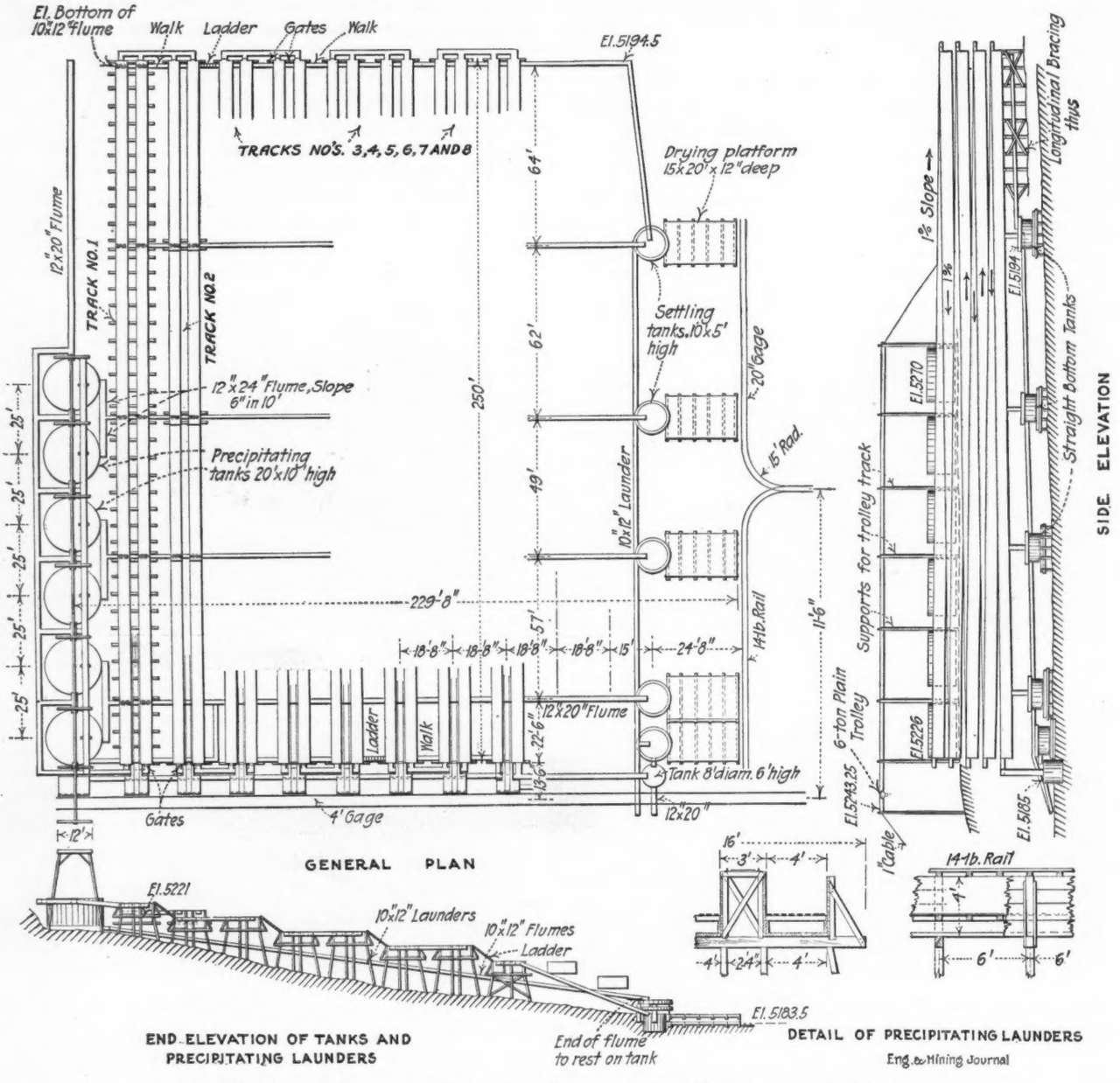
Settling Tank

*804 Louisiana St., Lawrence, Kan.

pine with a tongue-and-groove joint throughout. The bottom was first wedged in place, then nailed with iron nails. The sides of the flume were bolted and braced. A false bottom 8 in. from the true bottom supports the scrap iron. Baffle boards divide each flume into either four or five compartments and serve to regulate the depth of water. Stoppered holes at the ends of each compartment allow the cement copper to be sludged into the collecting launders below. A 24-in. gage track between each double flume is used to distribute the iron.

The double-flume arrangement permits the mine water to be diverted from one flume to the other during cleanup, while the sectional arrangement of each allows it to be cleaned one section at a time. When a flume is to be cleaned, the water is diverted, the stoppered holes in the bottom of the section are opened, the water drained into settling tanks or into some lower flume, and the copper then washed from the iron down through the false bottom into the launders to settling tanks by means of hose carrying water under pressure.

The third unit of the plant consists of a system of five redwood settling tanks of special design and two storage tanks. These settling tanks are 10 ft. in diameter, 5 ft. deep, with a 10x10-in. circular launder or lip around the periphery. The sludge from the precipitating tanks and flumes flows into these settling tanks,



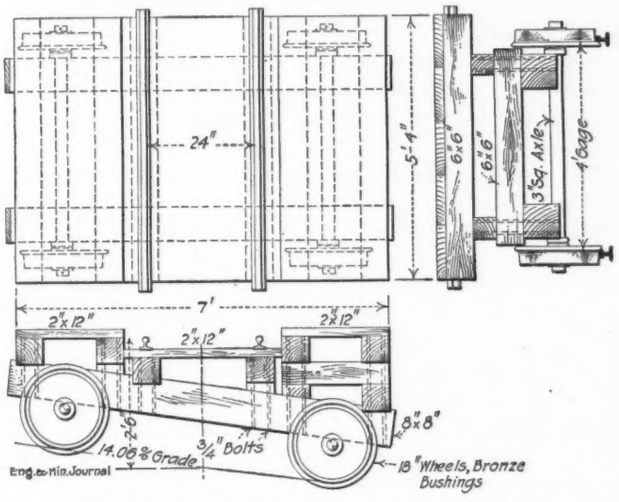
PLAN, ELEVATIONS AND DETAILS OF COPPER QUEEN PRECIPITATING PLANT

The drying vats are simply shallow wooden boxes, 20x 15 ft. by 12 in. deep. Here the cement copper air-dries for several days before it is collected for shipment to the smelter. From the vats the cement copper is shoveled

into end-dump mine cars and trammed down to the loading station, where it is run out over a movable track and dumped into railroad cars.

The scrap iron for precipitating purposes comes to the loading platform on railroad cars. From these it is lifted by a swinging-boom crane and placed in a small mine car, which rides upon an especially designed truck which carries the smaller car up an incline to the end of one of the flumes. Here the smaller car is run off on to the track, which runs over the top of the flume and the iron distributed along the flume where necessary. Heavy iron for the precipitating tanks is loaded directly on to the truck and pulled up the incline to the loading platform at the top. Here the iron is picked up by a six-ton traveling Triplex block and distributed to the tanks.

The inclined track is 4-ft. gage, and supported upon heavy wooden bents throughout. It has such a grade that the especially designed truck passes the ends of the flume



TRANSFER CAR FOR PRECIPITATION PLANT

tracks horizontally. This arrangement permits the mine car carrying scrap to be run off the truck on to the flume tracks, thus expediting the handling of quantities of scrap. The truck is drawn up the incline by an electric geared hoist.

The plant is designed to handle from 300 to 2500 gal. of mine water per minute, varying according to the seasons, the maximum amount usually being pumped during July and August. A sample of the water taken as it leaves the mine (Aug. 29, 1914), then filtered to free from matter in suspension, gave a partial analysis as shown:

COPPER QUEEN MINE WATER ANALYSIS

Constituent	Grams per liter
Fe, total	0.334
Fe (ic)	0.087
Fe (ous)	0.247
CaO	0.368
MgO	0.032
Al_2O_3	0.242
Mn	0.146
Cu	0.296
Zn	0.060
SO_4	3 4249
Au	Trace
Ag	Trace
Pb	None

The water, upon entering the plant proper, has practically the temperature of the air. This is due to its 3040 ft. of travel in an open flume before reaching the plant.

The plant is so designed that about 300,000 gal. of the outflow may be pumped back daily to the Holbrook shaft through an 8-in. wood-lined pipe, by means of a Triplex geared pump. The upper levels of the Holbrook mine were worked out years ago and the stopes gobbed with moderately rich waste. This offers an attractive field for enriching the mine water; so these old workings were drifted and crosscut and a system of pipes introduced which distributed the barren water through these drifts. This water percolates through the old gob or stope filling, leaching out the copper, and is collected in the sump on a lower level to be pumped back to the precipitating plant again. Water is also pumped through burning sulphide stopes to collect copper there.

The average extraction for the period July 1, 1914, to Sept. 1, 1914, was 98.11%. A series of samples taken from a representative flow of water as it passed different points in the plant gave the following data:

PRECIPITATING PLANT EXTRACTION

Contents— Grams per liter	Cu	Ferric iron	Free acid	Extraction %
Water leaving the mine, heads.	0.424	0.116	0.360	0.0
Entering precipitating tanks...	0.281	0.051	0.140	33.72
Leaving precipitating tanks....	0.169	0.031	....	60.14
Leaving the plant, tails.....	0.010	0.010	0.140	97.66

From the analytical data it may be seen that 33.72% of the copper is extracted in the flume leading to the plant, 26.41% of the total copper content is extracted in the six precipitating tanks, and 37.52% in the flumes, leaving 2.34% in the tails. Extraction also tends to vary with the seasons, being slightly higher in the winter and lower in the summer or rainy season.

The cement copper from the new plant is expected to be similar in quality to that produced by the old plant.[1] A typical sample of this precipitate contained 35% moisture and the dried sample assayed: 39.12% Cu; 16.5% Fe; 5.2% SiO_2; 2.0% CaO; 12.9% Al_2O_3; and 1.4% S. Calculating from the copper, ferric iron and free acid in heads and tails assays, it may be seen that theoretically 1.23 lb. of iron are consumed per pound of copper produced. Assuming the scrap to be 85% Fe gives 1.45 lb. iron per pound of copper produced.

The approximate cost of the plant was $35,000. A total of 350,000 ft. of lumber, at $21.50 per M laid down at the plant, was used in its construction. The cost of scrap is practically nil. The plant operates economically in point of attendance. It gives fair extractions and handles widely varying amounts of water of variable copper content.

Some difficulty was experienced in filling the plant for the first time, because of the lapse of time between completing the plant and connecting it up with the mine water. This lapse let the plant dry out, thus causing it to leak badly.

Wet Extraction of Mercury

A method to extract mercury from its ores in a wet way is outlined by Edwin B. Thornhill, of Gray Summit, Mo. (U. S. pat. 1,119,377). The plan is to treat the ore with a mixture of an alkaline sulphide and an alkaline hydrate, and to regenerate the solution by precipitating the mercury on a metal which does not form a sulphide in the wet way, such as aluminum or chromium. The reactions are:

$$HgS + Na_2S + x\,H_2O = Na_2S.HgS.x\,H_2O$$

$$3\,(Na_2S.HgS.x\,H_2O) + 8\,NaOH + 2\,Al = 6\,Na_2S + 3\,Hg + 2\,Na\,AlO_2 + xH_2O$$

It will be noted that sodium sulphide is formed at the expense of the hydrate.

[1]Eng. and Min. Journ., Oct. 31, 1913. H. W. Chittenden.

The Cost of Doing Things

Churn-Drilling Costs

By C. H. Palmer, Jr.*

The figures here presented were compiled from drilling operations recently completed at the property of the Pacific Mines Corporation, seven miles south of Ludlow, Calif., at which point the company's standard-gage railroad connects with the main line of the Atchison, Topeka & Santa Fé Railroad.

Twenty-four holes having an average depth of 258 ft. were drilled within a radius of 1100 ft. to prospect the extension of the present orebodies, which dip gently to the north. A Star rig No. 23 was used, and holes were drilled with an 8¼-in. bit and 2½-in. manila drill cable. When casing was required the hole was continued with a 6-in. bit. The work was done by two drilling crews, each consisting of a driller and a helper. On days when it was necessary to move the rig, both crews assisted. The driller received $6 a day and his helper $4.80.

An average of the formation passed through consisted of:

Wash formation, ft.	21
Trachyte porphyry, ft.	210
Kaolinized hanging wall, ft.	4
Ore zone, ft.	18
Quartz-monzonite foot wall, ft.	5
	258

No difficulty was encountered in drilling these formations, although the hanging-wall material was sticky and the hard-ore zone necessitated sharpening the bit about every 5 feet.

The topography is mild within the radius drilled. The weather is hot in summer and the country arid, the water-supply being obtained at Ludlow for $1.50 per 1000 gal. Coal costs $8.15 per ton delivered at the mine.

These holes required 45 lb. of coal and 21.6 gal. of water per foot drilled. The costs do not include those for moving the rig for drill-hole set-ups, which amounted to $215 for coal and water and $263 for labor. The accompanying table gives the distribution of time in the drilling operations:

TIME DISTRIBUTION

Total possible drilling hours—3092	Hr.	%
Actual drilling	2626	84.93
Casing	59	1.91
Removing casing	34	1.10
Repairing drilling machine and rope	141	4.56
Fishing for tools	19	0.61
Unforeseen delays	213	6.89
(Moving the rig for set-ups took in all 527 hr.)	3092	100.00

*Mining engineer, 1823 West 48th St., Los Angeles, Calif.

Wells Nos. 1 and 2, total footage drilled 811, having an average depth of 405 ft., were drilled for a water-supply for milling and domestic purposes, and were located about 5.5 miles east of the mine. The formation passed through consisted of wash, fine sand and clays. The costs and time distribution were as shown:

TIME DISTRIBUTION

Total possible drilling hours—703	Hr.	%
Actual drilling	444	63.16
Casing	78	11.10
Repairing drilling machine and rope	81	11.52
Fishing for tools	58	8.25
Unforeseen delays	42	5.97
(Moving the rig for set-ups took in all 149 hr.)	703	100.00

These holes required 61 lb. of coal and 22.5 gal. of water per foot drilled. Moving the rig for drill-hole set-ups cost $51 for coal and water and $192 for labor in addition to the above figures.

The higher per-foot cost, in comparison with holes Nos. 1-24, was due to the necessity of casing both the wells, while the distance from supplies and shops added to the cost in the form of teaming and repairs, respectively.

Well No. 3, total footage drilled 572, was drilled on the southern edge of a dry lake 7.8 miles north of Ludlow, Calif., and a short distance west of the Tonopah & Tidewater R.R. Drilling was carried on under difficult conditions. The excessive heat, accompanied by high winds, partly accounts for the high labor charges noted below. One drilling crew was used. Eight-inch pipe was used to case the hole, which was necessitated by caving, caused by the encountering of salt water flows in the dark clays.

The material drilled consisted of:

Wash formation, ft.	70
Yellow clay, ft.	180
Dark sticky clays, ft.	322
	572

The sticky clays made the progress slow and added to the water costs. Boulders also caused troubles and delays. Water was delivered to a point near the well by the T. & T. R.R. for $2.50 per 1000 gallons.

This hole required 100 lb. of coal and 61 gal. of water per foot drilled, the latter including the water used for the domestic purposes of two drillers for 95 days. The pipe was not recovered.

While the preceding costs seem high, they may be taken as a fair average by those contemplating drilling similar

RECORD OF HOLES 1 TO 24 INCLUSIVE TOTAL FOOTAGE DRILLED, 6186

	Fuel Coal	Oil and Grease	Firebrick	Labor	Cable	Water	Coke	Repair Parts and Tools	Unclassified	Sum Total
Total costs	1133.13	42.72	42.48	3700.0	686.06	335.97	102.40	258.06	155.72	6456.54
Foot costs	0.183	0.007	0.007	0.598	0.111	0.054	0.016	0.042	0.025	1.043
Per cent. of total cost	17.55	0.66	0.66	57.31	10.62	5.20	1.59	3.99	2.42	100.0

RECORD OF WELLS NOS. 1 AND 2

	Fuel Coal	Oil and Grease	Labor	Cable	Water	Coke	Repair Parts and Tools	Teaming	Unclassified	Sum Total
Total Costs	202.83	10.32	772.30	157.50	45.90	13.12	68.57	409.85	18.10	1698.49
Foot costs	0.250	0.013	0.952	0.194	0.057	0.016	0.084	0.505	0.022	2.093
Per cent. of total cost	11.94	0.61	45.47	9.28	2.71	0.77	4.04	24.14	1.06	100.00

RECORD OF WELL NO. 3

	Fuel Coal	Oil and Grease	Firebrick	Labor	Cable	Water	Coke	Repair Parts and Tools	Teaming	Pipe	Unclassified	Sum Total
Total costs	232.83	2.85	6.05	1141.50	221.56	99.40	13.80	37.15	168.58	589.16	1.13	2514.01
Foot costs	0.407	0.005	0.011	1.998	0.386	0.174	0.023	0.065	0.294	1.030	0.002	4.395
Per cent. of total cost	9.26	0.11	0.24	45.41	8.81	3.95	0.55	1.48	6.71	23.43	0.05	100.00

footages under the trying conditions of an arid country. Sand storms greatly hindered work on well No. 3 and excessive heat at night made sleep difficult. This decreased the efficiency of the drillers and is partly responsible for the high labor charges. An unavoidable loss of time resulted from these circumstances which had a corresponding effect of increasing the water and fuel costs.

Wells Nos. 1 and 2 were drilled under more suitable conditions than well No. 3, although far from satisfactory for efficient labor returns. As all drill and domestic supplies had to be carried a distance of 5.5 miles over heavy roads, teaming charges were high.

Conditions were more satisfactory for low costs while drilling holes Nos. 1 to 24 inc. Repair shops were at hand and living conditions were excellent. Boulders encountered in the wash formation retarded, however, the work; also drilling the hard-ore zone and monzonite, and often portions of the trachyte was very slow, which especially increased the fuel and labor charges.

Churn-Drill Costs at Miami

By H. P. Bowen*

During the last five years, the Miami Copper Co. has done about 44,500 ft. of churn drilling, consisting of 73 holes of an average depth of 605 ft. In this work two No. 23 Star traction machines, equipped with No. 24 boilers and derricks, were used. All holes were started with a 10-in. bit and in a few cases it was necessary to use the 4¼-in. tools to reach the desired depth. Two-inch manila rope rope was used in starting and this was replaced by ¾-in. steel drilling cable when water was encountered, which occurred usually at from 300 to 400 ft. One-half of the holes were drilled at the corners of 200-ft squares and the others on 400-ft. squares.

The drilling was divided into two 18-month periods, in each of which a nearly equal footage was drilled and the following scales of wages paid:

	Wages	
	First Period 12-hr. Shift	Second Period 8-hr. Shift
Foreman	$200.00 per month	$200.00 per month
Samplers	100.00 per month	100.00 per month
Drillers	6.00 per shift	5.00 per shift
Helpers	4.80 per shift	4.00 per shift
	9-hr. Shift	8-hr. Shift
Laborers	$2.00 per shift	$2.15 per shift
Machinists	4.25 per shift	4.25 per shift
Carpenters	4.25 per shift	4.25 per shift
Blacksmiths	4.25 per shift	4.25 per shift

Coal costs $8.30 f.o.b. Miami, and from $1 to $1.50 more delivered to the rigs.

After the completion of the second drilling period, all tools, casing and repair parts were collected, repaired and stored. The drills were taken down and rebuilt on new frames, new parts being used where necessary, new tubes were placed in the boilers and the engines lined up. The machines were then housed-in, giving practically two new machines. Besides ordinary running expenses, the accompanying statements include the original cost of the machines and the cost of rebuilding them, the cost of all repair parts, tools, and casing charged out to churn drilling, whether actually used or not, the cost of two buildings, one for churn-drill supplies and the other in which the drills were stored. No credit has been allowed for the value of the rebuilt machines nor for the still serviceable tools, casing and supplies.

*Miami Copper Co., Miami, Ariz.

The drilling cost of the two periods differed but slightly, the most noticeable variance being in the cost of repair parts which changed from 1c. per ft. for the first period to over 5c. per ft. for the second.

COSTS OF DRILLING

Item	Per Ft.	Item	Per Ft.
Churn drills	$0.849	Churn drill roads	$0.4382
Churn drill tools	0.2037	Water-supply expense	0.0415
Wire drilling cable	0.0336	Foreman	0.1289
Sand line	0.0080	Engineers and draftsmen	0.0689
Manila rope	0.0598	Samplers	0.1505
Belting	0.0045	Drillers and helpers	0.6460
Casing and drive shoes	0.0872	Tin and plate shop	0.0131
Repair parts	0.0316	Blacksmiths	0.0130
Coal and coke	0.2835	Machinists	0.0165
Lubricating oil and grease	0.0094	Carpenters	0.0095
Iron and steel	0.0049	Miscellaneous labor	0.0135
Galvanized and corrugated iron	0.0064	Grinding and assaying samples	0.0394
Bolts, nuts, washers and rivets	0.0010	Teaming	0.2376
Timber and lumber	0.0136		$2.6976
Coaloil and gasoline	0.0059	Supply warehouse	0.0097
Small tools	0.0019	Churn drill storehouse	0.0067
Packing and waste	0.0019	Casing racks	0.0028
Miscellaneous	0.0086	Rebuilding machines, etc.	0.0379
Pipe and fittings	0.0015		
Sample sacks	0.0203		
Sampler's supplies	0.0051		$2.7547
Engineering supplies	0.0037		

CHURN DRILL ROADS

Item	Per Ft. of Hole Drilled	Item	Per Ft. of Hole Drilled
Explosives	$0.0321	Labor	$0.3981
Tools and drill steel	0.0063		
Miscellaneous supplies	0.0017		$0.4382

WATER SUPPLY

Item	Per Ft. of Hole Drilled	Item	Per Ft. of Hole Drilled
Galvanized iron	$0.0032	Labor	$0.0114
Pipe and fittings	0.0256		
Miscellaneous supplies	0.0013		$0.0415

REBUILDING AND REPAIRING

Item		Item	
Foreman	$157.58	Iron and steel	$6.72
Drillers and helpers	498.50	Bolts, nuts, washers and rivets	8.46
Tinners and plate shop	53.81	Coal oil and gasoline	17.75
Blacksmiths	24.78	Small tools	3.07
Machinists	145.00	Packing and waste	14.27
Carpenters	83.62	Miscellaneous supplies	9.77
Miscellaneous labor	41.65		
Teaming	199.96		
Repair parts	415.20		$1680.14

Cost of Test Pitting

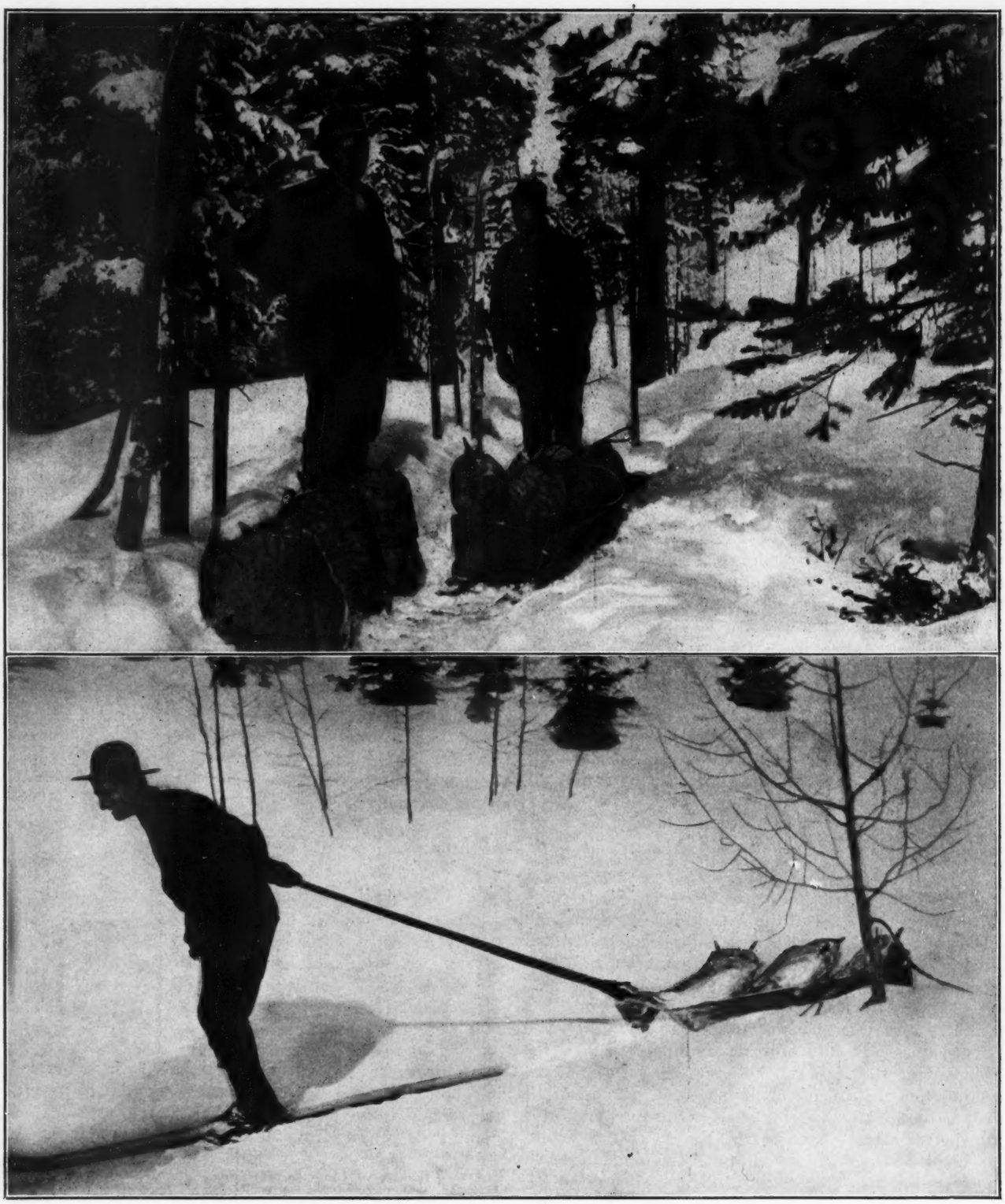
The following are actual costs of test pitting in hard clay and hardpan with many large boulders, where the ground dulls the picks rapidly. Foreman's wages were $3; laborers, $2. Two-inch hardwood plank was used for cribbing when necessary. No superintendence or office expense charged.

Pit	Depth, Feet	Hours Labor	Cost	Per Foot
1	17	80	$18.00	$1.06
2	24	140	29.00	1.21
3	7	15	3.50	0.50
4	22	75	16.50	0.75
5	23	100	24.00	1.04
6	26	240	48.00	1.84½
7	41	270	56.00	1.366
8	46	335	72.50	1.58
9	38	255	64.00	1.70
10	33	240	54.00	1.67
11	10	60	12.00	1.20
12	9	100	22.00	2.444
13	9	20	4.00	0.444
14	17	60	12.00	0.706
15	12	55	12.50	1.00
Filling pits Nos. 1, 2, 3, 4,			6.00	
Filling pits Nos. 5, 6, 7, 8, 9, 10,			35.00	
Filling pits Nos. 11, 12, 13, 14,			7.00	

The contract price for sinking a test pit in sandy soil and doing all necessary cribbing, all supplies to be furnished and tools sharpened free of charge, to 20 ft. in depth is $1 per ft.; from 20 to 30 ft., $1.25 per foot.

The Cleanup of Lena Gold Fields for the year ended Sept. 30, 1914, was 370,256 oz. from 873,635 cu.yd. washed; in addition, 28,901 oz. of gold were obtained from slag treatment and by purchase from outsiders, thus bringing the total value of the production handled by the company up to £1,500,150 (about $7,275,000). The properties are situated in the Irkutsk province of Siberia. Little washing is done between October and March owing to the gravel and water being frozen.

Photographs from the Field

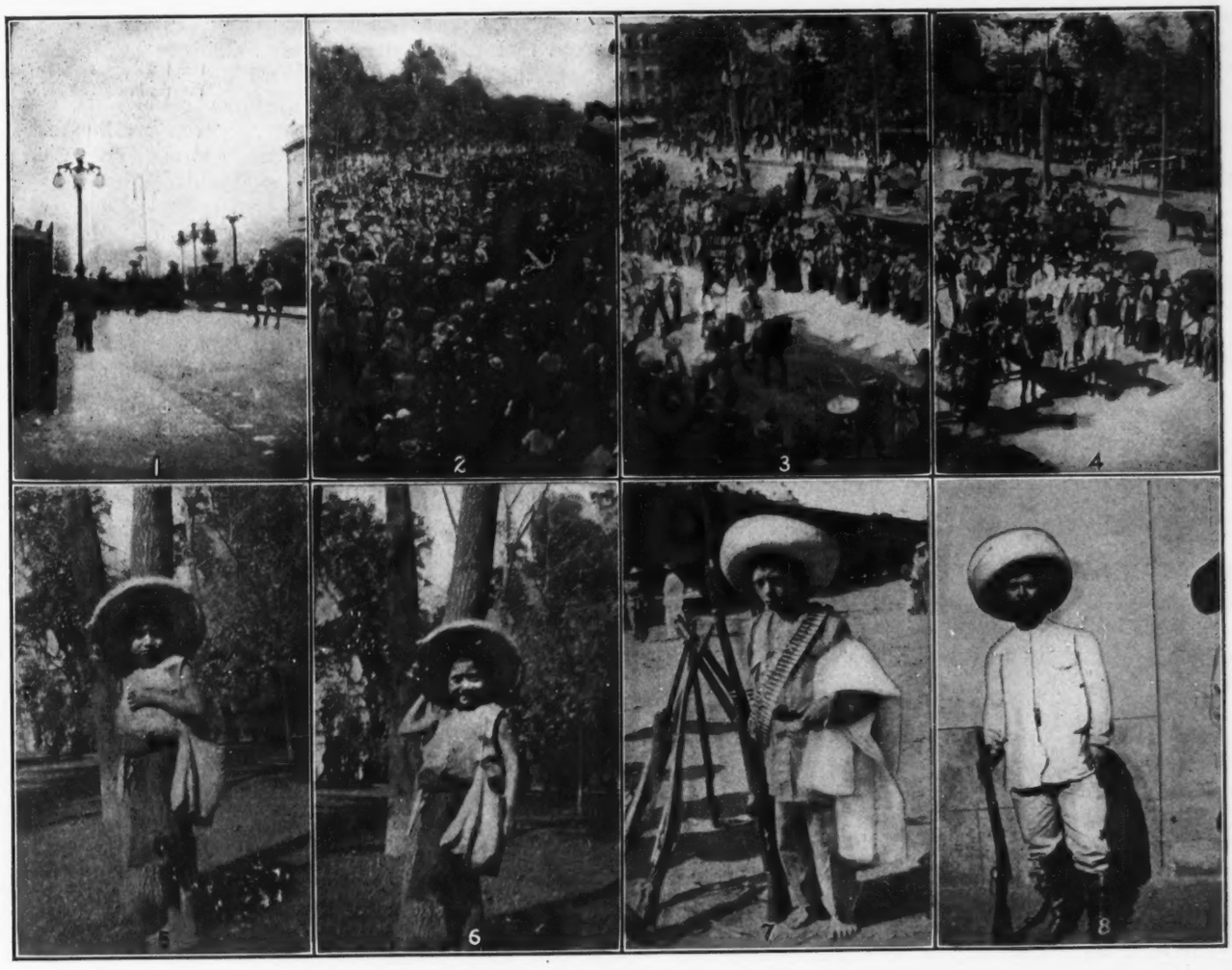


ORE TRANSPORTATION IN THE SAN JUAN BASIN, COLO.

Rich ore is loaded on sleds and hauled, by men, down the mountains to the railroad. The man on skis is traveling about 30 miles an hour.

OLD HARNEY PEAK TIN MILL, S. D.
Abandoned 20 years ago. A monument built by British capital.

HYDRAULIC MINING IN FLORIDA
Removing phosphate rock by placer-mining methods.



TYPICAL PRESENT-DAY SCENES IN MEXICO CITY

1. Carranzistas driving commandeered horses through the city before leaving. 2. Entry of Villa and Zapata, Dec. 6 1914. 3. Zapatistas with their banner demanding land division. 4. Villa leading his forces, on Dec. 6. 5 and 6. Indian boy before and after receiving his free dinner. 7. A boy soldier of Villa's army, nearly as tall as his rifle. 8. A Zapatista, typical except for his boots, which are unusual.

Lake Superior Iron Ore

The Lake season closed early in 1914, partly on account of slow business and partly by reason of bad weather. Shipments of iron ore from the upper ports in November were 1,070,092 tons, this including one cargo of 1411 tons from Escanaba, which did not get away until Dec. 1. For this season the shipments were just about two-thirds those of 1913. The rail shipments are not yet reported. The dock statistics, as collected by the *Marine Review*, give the shipments by ports for the entire season as follows, in long tons:

LAKE IRON ORE SHIPMENTS

	1913		1914	
	Tons	Per Cent.	Tons	Per Cent.
Escanaba	5,399,444	11.0	3,664,451	11.5
Marquette	3,137,617	6.4	1,755,726	5.5
Ashland	4,338,230	8 9	3,363,419	10.5
Two Harbors	10,075,718	20.6	5,610,262	17.5
Superior	13,788,343	27.9	11,309,748	35.3
Duluth	12,331,126	25.2	6,318,291	19.7
Total, water	49,070,478	100.0	32,021,897	100.0
Rail shipments	876,638			
Total	49,947,116			

Water shipments for 10 years past have been as follows:

Season	Tons	Season	Tons
1905	33,476,904	1910	42,620,201
1906	37,513,595	1911	32,130,411
1907	41,288,755	1912	47,435,777
1908	25,427,094	1913	49,070,488
1909	41,683,873	1914	32,021,897

This table shows that the shipments for 1914 were the smallest in 10 years, except those of 1908; though they were only 108,514 below those of 1911. The changes in the port shipments show that the Steel Corporation directed its efforts toward making up its minimum on the Hill leases, doing comparatively little on its other mines. This is plainly shown by the increase in the proportion shipped from Superior, coupled with the decreases at Duluth and Two Harbors. From the Minnesota ranges, the Mesabi, Vermilion and Cuyuna, the proportion did not change greatly, being 73.7% of the total in 1913 and 72.5% in 1914. These figures are approximate only, the production not being apportioned by ranges as yet.

Of the water shipments in 1914 a total of 25,402,655 tons, or 76.2%, went to Lake Erie ports. The shipments of those ports to furnaces have been as follows, for three years past:

	1912	1913	1914
On docks, May 1	6,029,941	5,909,829	5,920,157
Season receipts	37,472,108	39,099,647	25,402,655
Total	43,502,049	45,009,476	31,322,812
Shipments to furnaces	33,421,251	35,747,800	21,976,941
On docks, Dec. 1	10,080,798	9,261,676	9,345,871

The ore not delivered to Lake Erie ports went to Lake Michigan, chiefly to South Chicago and Gary.

The Hill Ore Lands

The following comments from the Cleveland *Iron Trade Review* well state the position of the Great Northern Trustees for next season: "In fact, it can be officially stated that the trustees will not permit their agents to make any special effort to sell a large tonnage at present prices. Unless the market improves materially, it is very probable the Great Northern will dispose of only a little ore during 1915. . . .

"In addition, the Great Northern properties are not in a position to ship any exceptional tonnage during the coming season. . . . The larger openpit producers which were operated by the Steel Corporation under the Hill lease, such as the Leonard, North and South Uno, Dale, etc., have been, to a great extent, mined out to the point where steam-shovel operations on a large scale are no longer profitable. These properties still contain large bodies of ore, but they will have to be reclaimed by scramming, milling, underground mining and other slower methods. It is to remedy this condition that the Great Northern is developing the large new Dunwoody and Hill Annex pits. The Hill Annex will not be in shape to ship at all in 1915 and the Dunwoody only a fraction of its eventual annual tonnage.

"Therefore, as far as 1915 is concerned, the Great Northern trustees would not be in a position to deluge the ore market, even if they were inclined to do so. They will have probably 2,500,000 tons available, a large proportion of which will remain in stockpiles, or in the openpits, unless the price of ore shows more strength than is now indicated."

Safety Rules for Wisconsin Zinc Mines

The accompanying set of regulations governing operations in the lead and zinc mines of Wisconsin will take effect Jan. 3, 1915. These were drawn up at the instance of the State Industrial Commission, actively represented by C. W. Price, assisted by a committee of mine operators in the Platteville district. This committee included W. N. Smith, manager, Vinegar Hill Zinc Co.; John Mculloch, general superintendent, Vinegar Hill Zinc Co.; H. C. George, mining engineer, Wisconsin Zinc Co.; James Billingsley, manager, Frontier Mining Co.; B. A. Hoskins, general manager, Mineral Point Zinc Co.; L. N. Dana, manager, Indian Mounds Mining Co.

The commission was created by the state legislature. It has power to investigate and to draw up and enforce regulations having to do with the safety and welfare of employees and its rulings are the same as the laws of the state. It is obvious, however, that no commission can be intimately familiar with all conditions prevailing in all industries in a state as large as Wisconsin. The commission, therefore, has adopted the plan of consulting with the operators in any given industry. A general meeting of the operators is held, a committee of operators is appointed, rules are drawn up, etc. A copy of these rules is sent to every operator by the industrial commission, for expressions of opinion, complaints and suggestions. They are finally approved or not by the commission. Following this general procedure, the committee mentioned above was appointed by vote at a meeting of mining operators held in Galena, Ill., in the spring of 1914.

The regulations follow:

General Regulations

(1) SHAFTS—HOISTING COMPARTMENT—All hoisting compartments hereafter sunk in which men are hoisted in cans by power hoists must be not less than 5½x5½ ft. in the clear.

(2) LADDERS IN SHAFTS—Every mine or isolated underground working reached by a vertical shaft only must have at least one shaft equipped with a substantial ladder. This ladder must be of sufficient strength to sustain a load of 200 lb. for each 8 ft. of length, and must be anchored at the bottom. No ladder shall be inclined backward.

NOTE—A substantial ladder can be constructed in the following manner: Uprights of 2x4-in. selected pine or fir; rounds of ¾-in. pipe or rods, set in mortises 1½ in. deep; uprights tied together every 8 ft. with a bolted rod. Ladders may be connected with wrought-iron or steel straps 1½x½x36 in., attached to each ladder with two ⅝-in. bolts.

(3) LADDERS IN SHAFTS BEING SUNK—Ladders must

be provided in all shafts in course of sinking to within such a distance of the bottom as will secure them from damage by blasting. From the end of such ladders chain or other extension ladders must be continued to the shaft bottom.

(4) RAILING AROUND TOP OF SHAFTS—Every shaft must be equipped at the top with a substantial railing not less than 3 ft. in height, constructed with two rails, the bottom rail being placed midway between the top rail and the floor. Every opening in the railing must be equipped with a bar or a gate. Where bars are used, lap bars with a lap of not less than 2 ft. are permissible.

(5) LIGHTING SHAFTS—In every mine the shaft in use must be lighted at the top and bottom landings with fixed lights.

(6) CABLE HOOK—The cable hook must be closed with a spring snap. All hooks must be made of Norway iron not less than ¼ in. in diameter. Hooks must be kept in good repair.

(7) TAMPING BARS AND POWDER PUNCHES—All tamping bars and powder punches must be of wood, or equipped with wood or copper tips.

(8) STORAGE OF DYNAMITE—Dynamite, caps or other explosives must not be stored or thawed in the change house or in other buildings frequented by employees. Dynamite and caps must be kept in separate magazines, both above and below ground. Only a sufficient quantity of explosives may be stored underground to meet the estimated requirements of the succeeding 24 hours. A suitable thawing house must be provided for use where high explosives are to be thawed. Such thawing house must not be heated with steam under pressure. Such thawing house should be located at least 300 ft. from mine structures and dwellings. Refuse must not be allowed to collect in the thawing house, and employees must not be permitted to prepare primers in either the thawing house or the magazine. A suitable magazine must be provided for the storage of high explosives. Where conditions will permit, a naturally isolated situation should be chosen as far from the mine buildings and dwellings as is practicable.

(9) HOISTING AND HAULING CABLES—All hoisting and haulage cables used in vertical and inclined shafts must have a factor of safety of not less than eight, by which it is meant that the ultimate strength of the cable must not be less than eight times the total weight on such cable. Spliced cables must not be used for hoisting. Hoisting cables must be securely fastened to the drum, and when in use must never be fully unwound, at least 1½ full turns being left on the drum.

(10) HOISTING EQUIPMENT—All mine hoists must be equipped with an efficient brake and also an additional device for stopping, such as a friction clutch or an auxiliary brake. The hand or foot levers used for operating the brake must be placed so as to be in immediate reach of the operator in any emergency. All parts of the hoisting apparatus must be kept in good repair.

(11) CAN BAILS—All can or tub bails must be made of Norway iron not less than 1¼ in. in diameter. Bails must never be welded. This order applies to cans of 1000 lb. capacity. On cans, skips, and cars of other capacities, the bails or attachments must be of proportionate strength.

(12) ATTACHMENTS OF CABLES—The cables must pass around an oval thimble, must lap back not less than 18 in. and must be securely fastened with not less than three cable clamps. A tapered socket with babbitt may be used.

(13) SIGNAL SYSTEM—All shafts where power hoists are used must be equipped with a signal system. A copy of the signal code must be posted at shaft landings and in hoist rooms. The following uniform code of signals must be used: One bell, start or stop; two bells, lower; three bells, prepare to hoist men; three bells followed by one bell, hoist men.

(14) CHANGE HOUSE—Where 20 or more men are employed underground, a sanitary change house must be provided. Such change house must be properly heated and must be supplied with water and adequate lavatories. The change house must be well lighted and kept in a clean and sanitary condition.

(15) MUD OR WATER AT COLLAR OF SHAFT—Pools of water or mud must not be permitted on the floor of the shaft house, at the shaft landing within 6 ft. of the entrance to the shaft way.

(16) GREASE AND OIL WASTE—Stairs in mine buildings must be kept free from oil and grease.

(17) VENTILATION—In mines where smoke, gases, or foul air are not removed by natural ventilation, after blasting, before the next shift starts work, some effective means of ventilation must be provided.

Rules for Employees

(1) READ THE RULES—Read these rules carefully and be sure you understand them. If you do not understand a rule, ask your foreman to explain. It is your duty thoroughly to understand these rules and to obey them.

(2) REPORTING INJURIES—In case of accident, no matter how slight the injury, even a slight cut or break of the skin, report at once to your foreman. Sometimes a slight cut or scratch will result in blood poisoning if neglected.

(3) CAUTION—Remember that working in mines and about machinery carries with it at all times an element of risk; you are asked always to be careful both for your own safety and for that of others, for many accidents are caused by someone's carelessness.

Hoistman

(1) No other than the authorized hoistman is to operate the hoist.

(2) The hoistman must be in the derrick at least 10 min. before the shift begins and must inspect each cable, hook and brake, and assure himself that everything is in safe condition. Before men are lowered, the empty can should be lowered and raised to make sure that everything is safe.

(3) Men must not be hoisted or lowered at a speed exceeding 600 ft. per minute.

(4) The hoistman must not hoist or lower more than four men at one time where cans are used for hoisting.

Miners

(1) Do not crowd around the shaft, top or bottom, when getting into the can.

(2) The tub hooker should be the first man to enter and the last man to leave the shaft, and all bell signals should be given by him.

(3) No man under the influence of intoxicating liquor will be permitted to enter the shaft and no liquor will be permitted on the premises.

(4) Each and every man employed in the mine must, upon entering the ground, examine the drifts wherein he may be and if bad or dangerous conditions are noticed he must report them to the ground boss at once. Do not work under a dangerous roof.

(5) Drill steel of lengths longer than 6 ft. shall not be hoisted with men in can.

Handling Explosives

ALL EMPLOYEES WHO HANDLE EXPLOSIVES MUST OBSERVE THE FOLLOWING RULES:

(1) Don't forget the nature of explosives. By sensible treatment they can be handled safely. Careless treatment makes them a source of imminent danger.

(2) Don't handle explosives so near an open light that there is danger from the flame or sparks.

(3) Smoking while handling explosives is strictly forbidden.

(4) Don't throw boxes of explosives or allow them to fall violently.

(5) Don't do tamping with iron or steel bars or tools. Use only the wooden tamping sticks provided for this work.

(6) Don't force a primer into a bore hole.

(7) Don't allow explosives to lie around loose in places where you are working.

(8) Don't leave blasting caps in the same box with dynamite or close to it.

(9) Don't carry blasting caps in your pocket, and don't tap or otherwise investigate them.

(10) Don't attempt to remove blasting caps from boxes by inserting nails or any sharp instrument.

(11) Don't tighten a cap around a fuse by biting it with your teeth, or by the use of a pocket knife. Use a cap crimper for that purpose, and use care in preparing your primers. A common cause of misfires is lack of careful attention in priming.

(12) Don't leave dynamite, fuse, or caps in a wet place.

(13) Don't use frozen or chilled dynamite. Don't cut or break a piece of dynamite while it is frozen.

(14) Don't use any arrangement for thawing dynamite other than the one provided by your employer.

(15) When a hole has missed fire the driller must not attempt to remove the charge from the hole, and must not drill within 2 ft. of such hole. Missed holes must be reported to the foreman.

(16) When squibbing a hole, either blow the hole out or wait until it has cooled before reloading.

(17) Dynamite must not be taken into the mine with caps and primers. Don't ride on the can with explosives.

Surface Men

(1) Men working around geared or belted machines must not wear coats or shirts with baggy or ragged sleeves, and overalls must be kept buttoned.

(2) When the guards are removed, a machine must not be started until the guards have been replaced

(3) Be careful around moving belts, pulleys, gears, setscrews, etc.

(4) Always apply belt dressing on the side of the belt running from the pulley.

(5) Never put on a belt or take it off while the machinery is running full speed.

(6) Don't oil elevator gears or tighten elevator or any gear boxes when machinery is running.

(7) See that all ladders have some good means to prevent slipping.

(8) Use great precaution in handling electric apparatus. A single shock may mean death or serious injury.

The Irtysh Corporation

The Irtysh Corporation, Ltd., has been formed in London to acquire from the Russo-Asiatic Corporation the issued share capital of the Ridder and Kirgiz mining companies which, constituted in accordance with the Russian law, hold the concession granted in the Ridder district of the Altai Imperial Estates and the Ekibastus coalfield. The Irtysh Corporation is capitalized at two millions sterling in £1 shares. The present issue, however, is of 6% debentures, £500,000 of which have been created. In addition to being convertible into fully paid shares at £2 10s. per share on or before Dec. 15, 1917, carry the right to an option on the companies' shares at par at the rate of 50 shares for a £100 debenture, for three years from the date of allotment of debentures or 1½ years after the declaration of peace between Great Britain and Germany, whichever period is the longer.

Satisfactory results have been obtained from the development work that has been in progress at the properties in the Altai district of Siberia, according to the technical report now issued. H. H. Knox, who reported on the Ridder mine, calculates that the explorations up to date have disclosed reserves of about 883,000 tons of solid sulphide, and 1,565,000 tons of disseminated ore, or a total of nearly 2,500,000 tons, which is estimated to contain an average profit of over £3 per ton, or a total profit in sight of £7,400,000. Besides this, Mr. Knox states that it is certain that as the explorations progress, further quantities will be added to this amount. A small ore-treatment plant has been erected on the Ridder mine, and it is expected that by the beginning of 1916 this mill will be enlarged to a capacity of 100 tons of solid sulphide ore daily; at the end of that year the mine and plant should be in a position to produce and treat 600 tons daily of mixed ore, or its equivalent of solid ore alone. Mr. Knox estimates that it will be necessary to provide £500,000 in cash, which, together with the profits accruing from the sale of products in 1916, should be sufficient for carrying out this program. The coal property at Ekibastus has been reported upon by Forster-Brown & Rees; this property is expected to earn profits by the sale of coal, in addition to providing the fuel for the lead and zinc-smelting plant which is to be erected to treat the products of the Ridder mine. The latter, it should be noted, is not the only mine included in the Ridder concession.

Petroleum Exhibit at San Francisco

The U. S. Bureau of Mines is to have exhibits at the Panama-Pacific in two buildings, that of Mines and Metallurgy and that of Machinery. The entire exhibit will include a pictorial display, a geological display, a statistical exhibit, a library of petroleum literature, a technological exhibit, a collection of crude and refined products, a display of housing and sanitary problems, lectures, and an exhibit of fire hazards with methods of prevention and fighting.

New Mine and Metallurgical Construction

Ash Creek Mining Co., Hornbrook, Calif., broke ground July 1 for a six-stamp mill with capacity of 18 tons, to cost $6000 and to be completed about Dec. 1.

Conzetti Mine, Cecilville, Calif.—Claims bonded to L. E. Spear under agreement to install a 10-ton mill unit every six months until capacity of 100 tons is obtained.

Mountain King Mining Co., Mountain King, Calif., broke ground Oct. 6 for a 150-ton 30-stamp concentrating plant, to cost $50,000 and to be completed in January, 1915.

Phoenix Cyanide Co., Johannesburg, Calif., completed Nov. 26 a 15- to 25-ton agitation and cyanide plant, costing $2500.

Standard Chemical Co., Naturita, Colo., completed Nov. 25 a 30-ton concentrating mill, costing $100,000.

Vindicator Consolidated Gold Mining Co., Independence, Colo., completed Oct. 15 a 500-ton concentrating mill, costing $40,000.

Pittsburg-Dolores Mining Co., Rockland via Yerington, Nev., broke ground June 1 for an 80-ton cyanide mill to cost $40,000, to be completed Apr. 1, 1915.

Northern Ore Co., Edwards, N. Y., broke ground Oct. 1 for a 50- to 100-ton concentrating mill, to be completed Dec. 1, 1914.

Golden Gate Mining Co., Greenhorn, Ore., broke ground July 1 for a 35-ton amalgamating plant, to cost $45,000, and to be completed about Jan. 1, 1915.

Utah Minerals Concentrating Co., Eureka, Utah, completed in November a 100-ton centrifugal concentrating plant, to treat Chief Consolidated ores.

Hammond Mining Co., Glacier, Wash., is reconstructing an old milling plant and adding modern cyanide equipment.

Field Mining & Milling Co., New Diggings, Wis., broke ground in December for a 450-ton zinc concentrating mill to cost $30,000 and to be completed in April, 1915.

Good Hope Mining Co., Keystone, S. D., broke ground Oct. 1 for a 10-stamp mill with a capacity of 40 tons, to cost $10,000 and to be completed Jan. 1, 1915.

Schumacher Gold Mines, Ltd., Schumacher, Ont., expects to break ground in April, 1915, for a 100-ton cyanide plant.

Reducing the Cost of Radium

The director of the United States Bureau of Mines announces in his annual report that the technical experts of the Bureau have devised a process for the extraction of radium from ores which can be used on a large scale and which is more efficient than that used by the largest foreign producers of radium. Doctor Holmes believes it possible that the cost of radium to the consumer will be reduced to one-third of the present price. He adds that, with radium now selling at $120,000 per gram, its reduction to $40,000 will result in many hospitals throughout the country being able to purchase a supply.

The process devised has already been tested with success in the plant of the National Radium Institute, which is under supervision of the mechanical staff of the Bureau of Mines. The process is to be patented and dedicated to the public.

December Mining Dividends

Mining dividends paid in December by 38 United States mining companies making public reports amounted to $7,383,297; metallurgical and holding companies paid $8,518,624; and eight Canadian and Mexican companies paid $690,394, as compared with payments of $9,230,918 by 41 companies for December, 1914, and $14,016,551 by metallurgical and holding and $1,174,110 by Mexican and Canadian companies.

United States Mining Companies	Situation	Per Share	Total
Argonaut, g	Calif.	0.10	$20,000
Boss, g	Nev.	0.10	40,850
Bunker Hill Con. g	Calif.	0.01	5,000
Bunker Hill & Sull., l.s.	Ida.	0.25	81,750
Butte & Superior, z	Mont.	0.75	406,703
Caledonia, l.s.	Ida.	0.01	26,050
Calumet & Arizona	Ariz.	0.50	308,356
Chino, c	Ariz.	0.50	432,410
Daly-Judge, l.s.	Utah	0.15	45,000
Federal M. & S. pfd., l.s.	Ida.	1.00	119,861
Gemini, g.s.	Utah	5.00	25,000
Golden Cycle, g.	Colo.	0.03	45,000
Hecla, l.s.	Ida.	0.01	10,000
Homestake, g.	S. D.	1.65	414,414
Iowa-Tiger, g.s.l.	Colo.	1.00	3,000
Iron Silver, s.l.g.	Colo.	0.10	50,000
Jumbo Extension, g.s.	Nev.	0.05	48,583
Moscow, g.s.c.z.	Utah.	0.03	27,000
Nevada Con., c	Nev.	0.37½	749,796
North Star, g	Calif.	0.70	175,000
Old Dominion M. & S.c.	Ariz.	0.50	81,000
Portland, g	Colo.	0.02	60,000
Quincy, c	Mich.	0.50	55,000
Saint Joseph, l.	Mo.	0.05	72,589
Silver King Con., s.	Utah	0.10	61,758
Strattons, g	Colo.	0.03	30,375
Stewart, s.l.	Ida.	0.20	247,652
Superior & Pittsburgh, c.	Ariz.	1.00	1,499,792
Tomboy, g	Colo.	0.48	150,660
United Globe, c.	Ariz.	7.00	161,000
Utah, c.	Utah	0.75	1,218,367
Utah Con., c.	Utah	0.50	150,000
Vindicator, g.*	Colo	0.06	90,000
Wolverine, c.	Mich.	2.00	120,000
Wolverine & Ariz., c.	Ariz.	0.20	19,431
Yak, s.l.	Colo.	0.04	40,000
Yellow Pine, l.s.z.	Nev.	0.03	30,000
Yukon, g	Alas.	0.07½	262,500
Iron, Industrial and Holding Companies	**Situation**	**Per Share**	**Total**
Am. Sm. & Ref., com	U.S.	$1.00	$500,000
Am. Sm. & Ref., pfd	Mex.	1.75	875,000
Great Northern Ore	Minn.	0.50	750,000
Inland Steel	Ill.	1.00	78,836
International Nickel, com	N.J., Can.	2.50	948,133
Lackawanna Steel	N. Y.	1.75	612,115
National Lead, pfd	U. S.	1.75	426,436
National Lead, com	U. S.	0.75	154,915
Old Dominion, c	Ariz.	0.50	146,677
Phelps, Dodge, c	Ariz., Mex.	3.50	1,575,000
U. S. Steel Co., com	U. S.	0.50	2,541,512
Canadian, Mexican and Central American Companies	**Situation**	**Per Share**	**Total**
Crown Reserve, s.	Ont.	0.02	35,376
Hedley, g.	B. C.	1.00	120,000
Hollinger, g	Ont.	0.15	90,000
Kerr Lake, s	Ont.	0.25	150,000
Lucky Tiger, g.s.	Mex.	0.09	64,380
Peterson Lake, s	Ont.	0.012	63,000
Seneca-Superior, s.	Ont.	0.10	47,638

A full review of the year's dividends will appear in the annual statistical number, issued on Jan. 9. The accompanying tables give the details of the December disbursements.

Tunnel Companies of the United States

A subscriber writes to the JOURNAL, asking us to print the names and addresses of tunnel companies which have paid dividends, or are now operating.

The accompanying list, perhaps not complete, at least presents the most important developments of the kind. As to profits, that question is more difficult to answer. Such undertakings are generally believed to be not particularly remunerative, but it is known that the Yak Tunnel has paid large sums in dividends, and the Mascotte is considered one of the best pieces of property in the Heinze estate. The list follows:

Sutro Tunnel, Virginia City, Nev.
Roosevelt Tunnel, Colorado Springs, Colo.
Newhouse Tunnel, Idaho Springs, Colo.
Yak Mining, Milling & Tunnel Co., Leadville, Colo.
The Big Five Tunnel, Ore Reduction & Transportation Co., Idaho Springs, Colo.
Mascotte Tunnel, Utah.

Samuel Franklin Emmons Memorial Fellowship

The friends of the late Dr. Samuel Franklin Emmons have established a fund, whose income may be used in support of a fellowship to promote investigations in the branches of geology which were cultivated by him, more especially on the economic side. The funds have been placed in charge of the Trustees of Columbia University, but the choice of the fellow and the expenditure of the income are intrusted to a committee consisting of Professors James F. Kemp, John D. Irving and Waldemar Lindgren. The committee announces that it will be prepared to award in March, 1915, a fellowship of $1000 for the year July 1, 1915, to June 30, 1916, inclusive. Applications must be made on blanks which will be furnished by the Secretary of Columbia University, New York, N. Y., and which, when filled and accompanied by testimonials and complete statements of the applicant's qualifications, will be submitted by him to the committee on Mar. 1, 1915. Applications must be received by the Secretary of Columbia University before this date.

The committee requires that applicants should be qualified by proper geological training and experience to undertake the investigation of some problem in or related to economic geology. Each candidate is expected to submit with his application a definite statement of the problem which he proposes to study. The carrying out of the investigation will be under the oversight of the committee and may be undertaken at any place or institution which may be preferred by the holder of the fellowship and which will meet the approval of the committee. The place and publication of results will be decided by the committee. The committee will require that the holder of the fellowship agree to give his entire time and energies to the problem selected, and further agree to contract no other engagements conflicting with or restricting this work without its consent. No objection will be made to the use of the results as a dissertation for the degree of Ph.D. in an approved university.

Tanalyk Corporation

In the report for the year ended Sept. 30, 1914, R. Gilman Brown, consulting engineer of the Tanalyk Corporation, operating near Kyshtim on the Russian side of the boundary, gives the following statement:

"Total developed ore and stocks amounted at the end of September to 185,000 tons, representing a profit value of £336,000, or sufficient to supply the present smelter and new cyanide plant for more than three years. A further profit of at least £126,000 is expected from ore not yet developed, but confidently expected to be won from the lower levels of Semeonovsky, and additional considerable profits from gold ore alone are indicated by

the preliminary work so far done on the outcrops of the other mines, ignoring the extremely good prospects of copper ore underlying these outcrops. With the first unit of the smelter at present working and on completion of the cyanide plant in the spring, profits at the rate of £100,000 per annum are expected. A newly organized geological department has discovered promising prospects at Abasass and Euluke, which are now being developed. The coal mine is opening up well and appears sufficient for all needs for some years to come. A narrow-gage railway has been constructed between the smeltery, Semeonovsky and Mambet, and is now being operated as a horse tram pending the arrival of the locomotives. Two campaigns of the new smelter have been completed, with satisfactory and improving results. Since Aug. 1, operations have been somewhat hampered by mobilization, this being chiefly felt in development and clerical work, and in delays to construction."

Phthisis Conditions on the Rand

By A. Cooper Key*

It involves no extravagance of language to characterize miners' phthisis as the scourge of the Rand mining industry. The mines employ from 20,000 to 24,000 white men, the unskilled work being performed by natives, although this is governed largely by the native labor available. Owing to the increased use of machine drills, the latter factor is not so important now as formerly. The prevalence of phthisis finally became so serious that in 1911 it was decided to give monetary grants to men no longer able to work. Previously stringent measures had been instituted by the Union of South Africa Mines Department, and the whole subject was brought under continuous investigation by the Miners' Phthisis Prevention Committee, composed of medical men and leading government and mining-company officials. The miners' phthisis act, 1912, elaborated the procedure and increased the allowances under the earlier enactment. It created a board to examine applications for financial relief, the amounts being determined according to the degree of severity of the disease. The secretary of the board stated recently that 4400 applications had been received under the present act, besides 1500 previously.

Over a Million Sterling Paid in Awards

Awards granted up to the end of January amounted to £1,163,000, but part of that will come back to the compensation fund. Medical examination disclosed no signs of silicosis in 335 cases. The men in the first stage receive £8 per month for a year, while those completely incapacitated are awarded £400. Under no conditions will the men be allowed to resume mining work.

Has the Disease Diminished?

Opinions differ as to the progress of the disease. The secretary for mines believes it likely that in four or five years the situation will be different. It is difficult to demonstrate any change now, as men have come in continually for the last five or ten years who are the victims of that period. From August, 1913, there was a rise in the number of applications, but that may have been due to the increased numbers of unemployed. Mr. Van der Merwe, chairman of the board, declared it was impossible to say whether the disease was diminishing, but his colleague saw no signs that it was. One of the medical witnesses thought the present applications were abnormal; and that they would decrease. R. W. Kolze, the government mining engineer, said it was too early to form an opinion as to the progress of the disease. Much of the evidence related to the feasibility of placing victims of incipient phthisis on the land, but one official witness was pessimistic regarding this solution. A mining director suggested that mine workers devote a portion of their earnings to a fund to enable them to return to the land.

Robust Recipients of Compensation

R. A. Barry, manager of the Nourse mines, and a member of the prevention committee, gave some remarkable examples of robust men who had received compensation: A drill packer, in one of the best places in the mine so far as dust is concerned, was at work 12 or 14 months. He secured £400 compensation, went to England and started a public house. There were grave loopholes in the act; men with phthisis came from other countries, managed to get past the doctors, were allowed to go underground, and applied for compensation, though the act stipulates they must have worked underground on the Rand for two out of the preceding four years. Another man who received £96 compensation is a professional football player with a chest expansion of 4 in. Men were certified who had little trace of phthisis, were paid compensation and were unable to go underground again, their livelihood being cut off. This shows that diagnosis of silicosis contains a good deal of guessing. Among the doctors there was some difference of opinion relative to the practical utility of X-ray examinations. Dr. Van Nekerk, medical inspector of mines, gave an instance of a worker who was found free from phthisis by two medical examiners. He was examined by X-ray and obtained a certificate rating him "badly affected with miners' phthisis, Class B."

Improvements in Dust Prevention

Various witnesses testified to recent improvements in the mines. Mr. Hindman, the Miners' Association witness, declared that the mines were doing their best work in the lines of water and supervision. The majority of the men observed the regulations regarding use of water, but more governmental inspection and supervision were necessary. This witness had been mining in various fields for 40 years and attributed his immunity and good health to the use of a respirator and the study of hygiene. Mr. Kolze, the government mining engineer, stated that on the whole the owners supported the department well. Engineers and managers gave all possible assistance and coöperation.

Amount of Dust

Medical members of the committee had not formed any definite opinion as to the relation between the amount of dust and the occurrence of the disease. They could not say that with such an amount as even 5 mg. per cu.m. a man could not certainly contract miners' phthisis. During the last year he had became less positive. A year ago he said that with such an enormous reduction as from 50 to 5 mg. of dust it must necessarily follow that a man

*Editor, "South African Mining Review," Johannesburg, South Africa.

could scarcely contract phthisis. The smaller quantity is about that which one gets in the streets, and he concluded that at that rate it would be a long time before a man would get phthisis. However, other facts had been accumulating. The dust found in the silicotic lung after death was of extraordinary fineness. That sampled in a mine is not all so fine, a certain portion being comparatively coarse, and apparently it is the fine dust which causes the trouble. The coarse might contribute, but that was not certain. It may be that, with all the precautions taken, the 5 mg. now remaining may be doing as much injury as the 50 or more before. Years would show how the disease was progressing. The dust found in postmortems was so fine that 50 particles in a row would be about as thick as a hair. He would not advise that mines, proved to be practically free of dust, should be removed from the list of contributors, as it was doubtful if they were not still causing phthisis. Five years hence a scheme might be evolved to relieve the financial pressure on a careful mine, on the basis of dust standards. The advance made in dust prevention and better ventilation during the last two years has been enormous.

Mining & Engineering Society of Alaska

It is reported that the Mining & Engineering Society of Alaska has been formed in Juneau. The following were officers elected: President, Charles E. Davidson; vice-president, H. T. Tripp; secretary, H. P. Crowther; executive committee, Philip Bradley, B. L. Thane, D. D. Muir, R. G. Wayland, C. E. Davidson and B. B. Neiding.

The object of the society, as set forth in the constitution adopted, is to take part in the advancement of the mining and engineering industries in Alaska, and to afford an opportunity for the better acquaintance and the exchange of experiences, ideas, and knowledge among and for the mutual benefit of its members.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALKALI AND ALKALINE-EARTH METALS, Process of Producing. Charles E. Acker, Ossining, N. Y., assignor to The Nitrogen Co. (U. S. No. 1,116,865; Nov. 10, 1914.)

ALKALIES—Process of Recovering Alkalies from Flue Gases of Cement Kilns. Spencer B. Newberry, Baybridge, Ohio, assignor of one-half to John R. Morron, New York, N. Y. (U. S. No. 1,121,532; Dec. 15, 1914.)

ALUMINO-SILICATES—Process of Producing Alumino-Silicates. Robert Gans, Grünewald-Berlin, Germany, assignor to Permutit-Aktiengesellschaft, Berlin, Germany. (U. S. No. 1,121,490; Dec. 15, 1914.)

ALUMINUM ALLOY—Alloy of Aluminum and Process of Making. Thomas A. Bayliss, Warwick, and Byron George Clark, London, England. (U. S. No. 1,117,308; Nov. 17, 1914.)

ALUMINUM ALLOY. William A. McAdams, Bay Shore, N. Y. (U. S. Nos. 1,121,267; 1,121,268; and 1,121,269; Dec. 15, 1914.)

AMALGAMATOR. Arthur James Robinson, Sheridan, Wyo., assignor of one-fourth to Arthur Bullock, one-fourth to James A. Thompson, and one-fourth to Thomas Leech, Sheridan, Wyo., and one-eighth to Richard Williams and one-eighth to Charles Grimm, Greer, Idaho. (U. S. No. 1,121,537; Dec. 15, 1914.)

ANNEALING FURNACE. Carl Kugel, Brunswick, Germany. (U. S. No. 1,118,869; Nov. 24, 1914.)

BRIQUETTE-MOLDING MACHINE. Wesley T. Collins, Colorado Springs, Colo. (U. S. No. 1,117,483; Nov. 17, 1914.)

BRIQUETTING—Method of Forming Agglomerated Bodies from Ores. Wilhelm Schumacher, Osnabrück, Germany, assignor to General Briquetting Co., New York, N. Y. (U. S. No. 1,121,048; Dec. 15, 1914.)

CONCENTRATION—Improvements in or Relating to Ore Concentration. G. A. Chapman, Miami, Ariz. (Brit. No. 18,937 of 1913.)

CONCENTRATOR. Louis Bowerman, Portland, Ore. (U. S. No. 1,118,393; Nov. 24, 1914.)

CONCENTRATOR—Shaking Ore Concentrator. John C. Smith, Salt Lake City, Utah. (U. S. No. 1,118,593; Nov. 24, 1914.)

CONCENTRATORS—Improvements in or Relating to Ore Concentrators. J. Weatherby, New Cumberland, Penn. (Brit. No. 19,302 of 1913.)

CONVEYOR ROLLS—Guard for Conveyor Rolls. Axel G. J. Rapp, Chicago, Ill., assignor to Link-Belt Co., Chicago, Ill. (U. S. No. 1,116,737; Nov. 10, 1914.)

CRUSHING or Pulverizing Mill. Thomas Joseph Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co. (U. S. No. 1,120,250; Dec. 8, 1914.)

CRUSHING—Reducing System. Milton F. Williams, St. Louis, Mo., assignor to Williams Patent Crusher & Pulverizer Co., St. Louis, Mo. (U. S. No. 1,116,777; Nov. 10, 1914.)

DRILL. Charles A. Dempsey, West Chicago, Ill., assignor of one-half to John F. Fowler, West Chicago, Ill. (U. S. No. 1,121,171; Dec. 15, 1914.)

DRILL—Percussive Hammer Drill, and the Like. William Henry Wakfer, South Norwood, England, assignor of one-half to Samuel Pack, Wallington, England. (U. S. Nos. 1,116,159—Nov. 10, 1914; and 1,119,330—Dec. 1, 1914.)

DRILLING MACHINES—Hydraulic Rotary Drilling Machine. Edgar E. Greve, Pittsburgh, Penn., assignor to Oil Well Supply Co., Pittsburgh, Penn. (U. S. No. 1,121,351; Dec. 15, 1914.)

DRILL STEM for Rotary Drilling Machines. Edgar E. Greve, Pittsburgh, Penn., assignor to Oil Well Supply Co., of Pittsburgh, Penn. (U. S. No. 1,117,835; Nov. 17, 1914.)

DRILLING MACHINE. William F. Fletcher, Drill, Va. (U. S. No. 1,117,825; Nov. 17, 1914.)

DRY CONCENTRATOR. Glen D. Harrington, Denver, Colo. (U. S. No. 1,119,950; Dec. 8, 1914.)

ELECTRIC FURNACE. William H. Hampton, New York, N. Y., assignor to The Conley Electric Furnace Co., Inc., Wilmington, Del. (U. S. No. 1,116,884; Nov. 10, 1914.)

ELECTRIC FURNACES—Improvements in Electric Furnaces. A. L. J. Queneau, Jemeppe sur Meuse, Belgium. (Brit. No. 10,061 of 1914.)

ELECTRIC REDUCTION FURNACE—Apparatus for Treating Metals. Samuel T. Wellman, Cleveland, Ohio. (U. S. No. 1,116,772; Nov. 10, 1914.)

ELECTROLYTIC RECOVERY—Improvements in the Electrolytic Recovery of Metals from Their Solutions and in Apparatus Therefor. V. C. Tainton and M. F. L. A. Aymard, Johannesburg, Transvaal. (Brit. No. 19,669 of 1913.)

EXPLOSIVE—Aluminum-Glazed Black Powder. Fin Sparre, Wilmington, Del., assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. (U. S. No. 1,116,944; Nov. 10, 1914.)

FILTER PRESS. Orange James Salisbury, Salt Lake City, Utah. (U. S. No. 1,120,628; Dec. 8, 1914.)

FILTERING APPARATUS. Orange J. Salisbury, Salt Lake City, Utah. (U. S. No. 1,120,629; Dec. 8, 1914.)

GOLD AND PLATINUM RECOVERY. Process of Recovering Rusty Gold and Native Platinum Metals. Robert E. Lyons, Bloomington, Ind. (U. S. No. 1,118,944; Dec. 1, 1914.)

GRAPHITE—Dry Deflocculated Body and Method of Preparing Same. Clinton Paul Townsend, Washington, D. C., assignor to Acheson Oildag Co., Niagara Falls, N. Y. (U. S. No. 1,116,957; Nov. 10, 1914.)

HARDENING—Improvements Relating to the Local Hardening of Iron and Malleable Iron Castings. (Vickers, Ltd., River Don Works, Sheffield, and C. L. Sumpter, Derby, Eng. (Brit. No. 18,643 of 1913.)

HEATER. Utley Wedge, Ardmore, Penn. (U. S. No. 1,121,314; Dec. 15, 1914.)

HEATING AND SMELTING FURNACE. William N. Best, New York, N. Y. (U. S. No. 1,119,227; Dec. 1, 1914.)

HOT-BLAST STOVE. Joseph E. Hausfeld, Cincinnati, Ohio, assignor to The Huenefeld Co., Cincinnati, Ohio. (U. S. No. 1,121,557; Dec. 15, 1914.)

INGOT CASTING. Alexander George McKenna, Washington, D. C. (U. S. No. 1,119,088; Dec. 1, 1914.)

LAMPS—Water-Feed for Acetylene Lamps. John M. Downing, East St. Louis, Ill. (U. S. No. 1,119,936; Dec. 8, 1914.)

LEAD PIGMENT—Process of Oxidizing Lead. Clifford D. Holley, Detroit, Mich., assignor to Acme White Lead & Color Works, Detroit, Mich. (U. S. No. 1,116,702; Nov. 10, 1914.)

MELTING FURNACE. Isaiah Hall, Birmingham, England. (U. S. Nos. 1,117,666; and 1,117,667; Nov. 17, 1914.

MELTING FURNACE—Furnace for Melting and Alloying Metals in Vacuo. William Speirs Simpson, London, England. (U. S. No. 1,118,820; Nov. 24, 1914.)

MELTING FURNACE—Furnace for Melting and Refining Copper. Walter S. Rockey, West New Brighton, Hilliary Eldridge, Stapleton, and Carle Dawes Clark, New York, N. Y., assignors to Metallurgical Research Co., New York, N. Y. (U. S. No. 1,119.540; Dec. 1, 1914.)

TIN—Process of Detinning. Josef Weber, Essen-on-the-Ruhr, Germany. (U. S. No. 1,115,262; Oct. 27, 1914.)

TIN—Process of Obtaining the Tin from Waste Tinned Metal. Gustav von der Linde, St. Tönis, near Crefeld, Germany. (U. S. No. 1,116,176; Nov. 3, 1914.)

TUBE MILL. Olaf E. Mogensen, Plainfield, N. J., assignor to F. L. Smidth & Co., New York, N. Y. (U. S. No. 1,115,715; Nov. 3, 1914.)

TUYERE VALVE. Henry Alinder, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (U. S. No. 1,118,613; Nov. 24, 1914.)

ZINC—Process of Smelting Zinc Ores. James M. Hyde, Berkeley, Calif. (U. S. No. 1,118,012; Nov. 24, 1914.)

ZINC OXIDE—Process of Producing Pure Zinc Oxide. Henry William de Stucklé, Paris, France. (U. S. No. 1,118,894; Nov. 24, 1914.)

Editorials

Canada's Nickel Trouble

Our Canadian friends have been greatly exercised about what may become of the nickel produced by the mines at Sudbury. The chief of these is owned by a subsidiary of the International Nickel Co., an American corporation. Canada herself is the great producer of nickel, but is not a consumer. In fact, Canada is not even a refiner, most of the roughly smelted product of Sudbury being brought to New York for refining. This happened through perfectly natural ways.

In the early days of the International Nickel Co., when the refining of the Sudbury matte was done by the Orford Copper Co. as a separate concern, a great deal of money was spent in an endeavor to work out a process as satisfactory and as economical as that of the Orford. This, however, was found to be impossible, and the International Nickel Co., to protect its own interests, was finally forced to take over the Orford company. This purchase represented a large investment, and in the event of a Canadian export duty being placed on nickel matte, the International would be forced to build a refinery in Canada, and the investment in the Orford plant would be almost a total loss. The Orford plant is exceptionally well situated as regards labor, source of raw materials, market and transportation.

However, the Canadians have been greatly agitated ever since the war broke out regarding the destination of the nickel refined from their ore in the United States. It has been charged by the newspapers that Germany has continued to receive nickel from the International, that the policy of that company was to a large extent dictated by German stockholders, and that, in fact, the Krupp concern itself is an important stockholder.

Such charges naturally created an awkward situation. Any measures that would compel a closure of the Sudbury mines could not be calmly contemplated for that would mean the loss of employment by a good many men. On the other hand, the American owner of the ore, having brought it to its only place for refining, had naturally the right to do what it wanted to with its own. In this juncture, Mr. Monell, president of the International Nickel Co., made the following statement a few days ago:

TO THE CANADIAN PUBLIC

In view of the wide-spread comment in the Canadian daily and technical press as to the destination of shipments of nickel made and being made by the International Nickel Co., and obtained from material of Canadian origin, as well as the references to a European controlling influence in its affairs, the company begs to submit to the Canadian public the following statements of facts:

(1) There is absolutely no influence exerted in the conduct of the affairs of the company, or of any of its subsidiaries, by any European steel-manufacturing or similar industry, nor by any individual connected with them, nor by anyone in European financial circles.

(2) Full information as to the destination of shipments of nickel made by the company has been in the possession of the Dominion authorities since the outbreak of the European war and they are currently kept cognizant of all exports of nickel, as well as of all local shipments made by the company.

(3) While recognizing that refining at the point of production, i.e., the mines, is the ideal condition, economic conditions, seriously affecting cost of production, have dictated the present location of nickel refining, and with the present state of the art, any material change in such economic conditions would react in a manner most detrimental to the Canadian nickel industry.

THE INTERNATIONAL NICKEL CO.,
A. MONELL,
President.

It will be observed that Mr. Monell does not deny foreign stock interests in his company, which is, of course, something beyond the company's control, it being a public concern whose shares may be freely bought; but he is sufficiently specific in his repudiation of the charges of European influence in the management of the company's affairs. As for the rest, the attitude of the International Nickel Co. ought to satisfy the Canadian people. It has, in fact, acted as if it were a Canadian corporation, keeping the Sudbury mines going while keeping their product away from Canada's enemy. We suppose that may properly be said, inasmuch as keeping the Ottawa government informed implies governmental sanction.

However, the statement of the International Nickel Co. appears to have failed to allay the excitement in Canada, where in the present temper of the people economic arguments do not carry much weight, and there is evidently a strong public sentiment in favor of the government putting an embargo on nickel regardless of consequences. This is being urged by a strong part of the daily press, which says bluntly that they want the assurance of the Dominion Government, not of the International Nickel Co., that everything is all right. The manner in which this is being made a political issue is illustrated by the Toronto *Telegram,* which shouts: "The present situation is that Britishers and other enemies to the Teutonic armies are being shot down by machine guns hardened with Ontario nickel and not an Ontario boy goes into action except at the risk of having to face bullets barbed with the nickel of which his own native province has a monopoly." The Toronto *World,* commenting on the statement of the International Nickel Co., remarks that "Certainly there is not a word of denial of the fact that Germany has got most of the nickel in her warships and torpedo boats that have sent so many British sailors to the bottom of the sea, and the nickel bullets that have ended the lives of so many British soldiers, Canadians included, from the nickel deposits of Ontario."

Of course, there is a good deal of claptrap in such talk, but it is inflaming the public and provoking a delicate situation of which a solution may have to be the purchasing of the International Nickel Co. by the Canadian government, as one Canadian paper ingeniously suggests. But, of course, the government may declare its own part in the supervision of the business. What if the government should be forced to prohibit nickel exports, shutting up the Sudbury mines, and preventing Bethlehem from furnishing nickel-steel to the Allies? The whole question bristles with difficulties.

On Dec. 26 the Canadian government issued a memorandum with regard to the export of nickel matte from

Canada to the United States, stating that the whole subject has been under careful consideration and investigation and that they have been in frequent communication with the British government as to the precautions which should be taken to prevent export to Germany. The books of the International Nickel Co., at New York, are inspected at short intervals by a thoroughly trained and experienced accountant, who goes into all exports, and reports to the Canadian government. By an arrangement between the company and the British government, certain control is exercised in London through the company's British representatives. The company is not under German control, the vast majority of the stock being held in the United States. There may be a few German shareholders, but the proportion is insignificant and there are no German directors. The steps taken by the Canadian government have the approval and sanction of the British government, which expresses itself entirely satisfied with the precautions taken. The memorandum goes on to point out that nickel is used in a large number of American industries and prohibition of the export, except for the most urgent reasons, would be undesirable as it would produce great business disturbance in a country whose sympathies are strongly with the cause of the Allies. Moreover, the government is informed that there is an output of nickel in Norway, controlled by German interests, which could furnish a supply for German requirements during the war.

This memorandum will probably have the effect of allaying the agitation so far as the supporters of the government are concerned, and though it may be continued by the sensational press and opposition partisans, it is not likely in view of the explicit statements of the government to lead to any practical result.

The Copper Export Controversy Again

The means that have been taken to keep Germany from getting copper up to this time appear to be substantially as follows: Holland has agreed not to permit the passage of copper through its domain. Italy has put an embargo on the exportation of copper, and permits importations to be made only under its own supervision, but does not interfere with the passage through Italy of copper destined to Switzerland. This may be, however, only for Swiss consumption, inasmuch as Switzerland herself has put an embargo upon the exportation of copper. Great Britain also made agreements with Denmark, Sweden and Norway, whereby they do not permit copper to pass to Germany, Great Britain agreeing, on the other hand, not to interfere with consignments to special persons in those countries with certificates of guarantee against reëxportation. Thus Germany's gateways are effectively closed and the copper manufacturing industries of that country are suffering keenly.

It is argued that Germany has enough copper of her own production to serve all of her military purposes and that the exclusion of foreign copper is merely detrimental to her industries and conveniences, while certainly it is detrimental to American producing interests. However this may be, Great Britain and her allies have effectively closed the gateways to Germany, wherefore the memorandum from Washington to London, Dec. 24, expressing in vigorous language the American opposition to British interference with neutral commerce, is probably more academic than anything else in so far as copper is concerned.

One of the chief complaints made in this note is against the British treatment of American cargoes of copper. Washington also sets forth its position on consignments shipped "to order," stating that this circumstance alone is not sufficient on which to hold American cargoes, and is not of itself a matter to arouse suspicion. This view has been expressed by the Supreme Court of the United States, but Great Britain announced recently that cargoes shipped "to order" would be regarded as "suspect." In this connection the American note remarks that commerce between neutral nations constitutes the normal relations of peace and not war, and that the presumption of guilt cannot rest on neutral shippers, but the burden of proof must be imposed on the belligerent who interferes.

This seems to be a strong statement of the American case, and it will not be surprising to find Great Britain agreeing to the principle, but unfortunately that is not going to reopen the German market so long as the countries contiguous to Germany maintain their embargoes.

The Status of Copper Hydrometallurgy

The hydrometallurgy of copper during 1914 has been confined largely to the development of electrolytic precipitation with insoluble anodes. As predicted in the JOURNAL a year or more ago, this has been focused on the use of sulphur dioxide as a depolarizer, although it may be characterized by less euphonious terms in the several patented processes. Experimentation has continued in Arizona along these lines and also with the use of weaker acid lixiviants, without any unexpected or startling developments.

The Nevada-Douglas metallurgists, after a careful series of experiments on sulphuric-acid leaching and electrolytic precipitation with the use of sulphur dioxide, abandoned this method entirely and are reported to have started the installation of the Rankin nitric-acid process. We have not heard any details of the operations with the latter. In view of the magnitude under which leaching processes will have to be conducted on low-grade ores, it seems improbable that it can be made a commercial success for general use. The Butte & Duluth metallurgists also pronounced the supposed advantage of sulphur dioxide as a depolarizer to be a fallacy, and abandoned its use as an acid maker, and stuck to straight electrolytic precipitation.

The Copper Queen metallurgists adhere to the idea of electrolytic precipitation and seem still to have faith in sulphuric dioxide. Chuquicamata will precipitate electrolytically, but will operate under conditions peculiar to itself. The Anaconda company, which is keeping one foot firmly on the ground before it steps off into the quicksand of inexperience, has begun the construction of its gigantic leaching plant, but will precipitate its copper in the time-honored way, using scrap iron, which will be supplemented by iron sponge made from calcined ore. It has been demonstrated that this sponge iron can be made easily and cheaply.

With regard to the use of lixiviants other than sul-

phuric acid, the Calumet & Hecla has been planning to leach with ammonia, but lately not much has been heard about plans from that quarter and there is a suspicion that some snags have been encountered.

The upset in copper conditions produced by the war has taken the heart out of many who were planning new enterprises and lately we have not heard so much about hydrometallurgical plans as we did early in 1914, but we have heard something surprising in a communication from Stuart Croasdale, who wrote as follows:

However, the leaven of metallurgical progress is working so quietly and rapidly throughout the mass of research investigation that it now seems almost safe to predict that copper leaching, as a commercial metallurgical process, will become obsolete for ores in the United States before any of the contemplated plants are completed, and there is every promise that oxidized and mixed copper ores, even though they contain gold and silver, can be eventually treated by simpler and cheaper processes.

Mr. Croasdale is one of the hydrometallurgical pioneers and has been enthusiastic respecting copper prospects in that direction. But now apparently he sees a better and easier field to plow.

Mr. Hammond Proposes a Pan-American Court

John Hays Hammond, at the December luncheon of the Manufacturers' Export Association in New York, suggested the formation of a Pan-American Supreme Court charged with deciding disputes which arise between the commercial interests of this country and of Latin America. Mr. Hammond believes that this court would assure investors of fair treatment and result in attracting capital. He said: "If inspired only by self-interest, the aim of such a court would obviously be to establish confidence in the security of Latin-American investments, and for that reason foreign investors would be assured of fair treatment." Latin-American governments, with a few exceptions, are undoubtedly becoming more stable, but some definite form of assurance is required to change public opinion. The investing public has been accustomed to thinking of each new revolution or government canceling the rights granted by its predecessors, tying up or sacrificing capital that had been invested in the preliminary phases of an enterprise.

Certain citizens of the United States have invested in some extremely successful mining and agricultural operations in Central and South America, but the great majority of investors in the United States have been deterred from entering into Latin-American enterprises by a fancied (or real) insecurity of such investments, as well as by the supine and vacillating foreign policy of the United States in the protection of its citizens. Much capital would undoubtedly flow to Latin America now, if these impediments were removed. There are great mineral possibilities in these countries, but in the United States the appreciation of these possibilities is largely confined to mining engineers, who are impotent without capital. The average investor who supplies the money for new enterprises is still obsessed by the idea that there is no security for his investment in Latin America. If a Pan-American Supreme Court will secure such investments from revolutionary troubles, unreasonable imposts and practical confiscation, the way would be cleared for a further flow of American capital to our neighbors on the south.

BY THE WAY

Now it appears that the bane of apex litigation has fallen upon Tonopah. Some suits have already been started and more are to follow.

Someone who is evidently interested in disaster is furnishing New York and Boston daily papers with alarming accounts about the scarcity of manganese. The alleged facts in most of these paragraphs are skillfully selected and arranged to give them an appearance of truth, but they are very far from presenting the real case. As a matter of fact, ferromanganese can be had at $65@70 per ton, and we do not know of any steel maker who is particularly worried about future supply. The intimation in a Boston contemporary that steel production in this country must cease about New Year need alarm nobody.

A well known New York engineer quotes a letter from a correspondent in Petrograd who says that there are now 500,000 tons of goods piled up at Archangel, while the only railway leading from there, a line of 42-in. gage, has capacity for the carriage of but 1500 tons per day one way. We think the estimate of total quantity is probably exaggerated, inasmuch as it would imply 100 to 200 shiploads, which would be a surprising number, although we know that things have been very busy in Archangel during recent months. As to railway capacity, the operation of the Trans-Siberian in the Japanese war made us very respectful of the Russian ability in railroading.

Every copper producer is tired of the remarks of his friends unacquainted with the copper business to the effect of something like this: "You copper producers are profiting greatly by the war, of course. Well, it's an ill wind that blows nobody good. Go to it and make hay while the sun shines." The copper producer wearily explains that the war having cut off America's largest customer put the copper business in a desperate condition from which it has become only moderately convalescent, being still on crutches and not able to stand without them. His ingenuous friend expresses surprise and remarks that he thought the manufacture of ammunition required a large amount of copper. So it does, but the consumption of copper for military purposes is trifling in comparison with the consumption for peaceful purposes that has been so largely checked. Cartridge cases do not amount to much in comparison with trolley wires.

Park City Mills

In an article describing the equipment at the Park City Mills, in the JOURNAL of Nov. 28, mention was made of estimated operating costs, and under this head some tests made by the Mines Operating Co. "It was estimated by the Mines Operating Co. that the costs would amount to about $2.50 a ton in a modern 50-ton plant." Owing to possible ambiguity as to what these costs were based on, it may be stated that these tests were made with the Holt-Dern roaster at the Mines Operating Co.'s plant.

PERSONALS

C. Colcock Jones is in southwestern Utah.

J. R. Finlay is now at Grass Valley, California.

C. H. Poirier, manager of the Porcupine Vipond mine at Porcupine, Ont., is in New York.

A. W. Newberry has been in the neighborhood of Barnwell, Calif., and has now returned to Los Angeles.

H. W. Turner arrived in New York from London Dec. 21 and left for San Francisco on the following day.

E. E. Whitely is now assistant superintendent of the Calumet & Arizona Mining Co. at Bisbee, Ariz. D. M. Rait has been made chief engineer of the company.

H. N. Lawrie, chairman of the Oregon Bureau of Mines and Geology Commission, Portland, Ore., was in Chicago recently to attend the dinner and meeting of the Chicago Section of the A. I. M. E.

George Howard Ferguson, member of the Ontario Legislature for Grenville, has been appointed provincial Minister of Lands, Forests and Mines, in succession to Hon. W. H. Hearst, recently appointed Premier.

Woolsey McA. Johnson has resigned as first vice-president of Johnson Electric Smelting, Inc., but continues to be a director in the company and its consulting engineer. Construction work at Keokuk, Iowa, has not yet been begun.

Capt. M. Cooney, a pioneer Mogollon mining man and member of the board of regents of the New Mexico School of Mines, has been missing since Oct. 25 and is believed to be lost in the Mogollon mountains. Searching parties are being organized to scour the country for him.

Frederick P. Dewey is Acting Director of the Mint in place of George E. Roberts, lately resigned. We do not know that Mr. Dewey is a candidate for the Mint directorship, but the idea occurs to us that he would be an excellent director of that bureau and his long service with it entitles him to the honor.

News that we published last week about the wounding of Robeson T. White caused a good deal of alarm among his many friends. This was relieved by the receipt of a cable dispatch, Dec. 28, communicated by Mr. White from Tiflis through the London office of the Caucasus Copper Co. Mr. White reported that his wound was slight and that he is now nearly recovered.

Quincy A. Shaw, president of the Calumet & Hecla Mining Co., has been compelled to relinquish all business as well as his diversified athletic and social activities, because of a physical and nervous breakdown, according to a statement made by his uncle, Maj. Henry L. Higginson, Dec. 24. The condition of Mr. Shaw, who is widely known through his management of the mining interests in Michigan organized by his father, the late Quincy A. Shaw, and his participation in sports, is said to have been due to overwork. He is now in the care of physicians, who have imposed upon him the restriction of complete rest.

W. L. Jones, vice-president and general manager of the Jones & Laughlin Steel Co., has announced that Capt. Thomas Walters, manager of the company's mines in the Lake Superior district, and who tendered his resignation to take effect the first of the year, will be succeeded by Mark Elliott, of Virginia, Minn., and Charles T. Kruse, of Ishpeming. Mr. Elliott will look after the company's affairs in Minnesota, while Mr. Kruse will have charge of the mines in Michigan. At the present time Jones & Laughlin have 11 mines in Minnesota and four in Michigan. Mr. Kruse will continue to act as auditor for the Lake Superior district. Thomas Walters, Jr., of Ishpeming, will be assistant to Mr. Kruse in the underground work in the Michigan mines. The announcement that Mr. Kruse and Mr. Elliott would succeed Captain Walters was well received in the Lake country, where both have spent the greater part of their lives and where they are well known.

OBITUARY

Thomas O'Brien, one of the pioneers of Colorado, and for many years a well known miner there, died at Denver, Dec. 11, aged 75 years.

John H. Hancock, chemist at the Ray Consolidated mill at Hayden, Ariz., was accidentally killed while hunting near that place, Dec. 16. He was 25 years old and had been at Hayden four years.

Matthew Sullivan died at Butte, Mont., Dec. 15, aged 75 years. He was born in Ireland and came to the United States in 1862. After mining in California and Nevada, he went to Butte in 1880 and had lived there ever since. He was a close friend and associate of Marcus Daly. He retired from active work 10 years ago.

Mark Birmingham died in New York, Dec. 23, aged about 85 years. He was owner of the controlling interest in the old Mariposa mine, and more recently, through success in a long-fought law suit, chief owner of the Candelaria gold and silver mines at Durango, Mexico. He was one of four brothers, sons of David Birmingham, of Montgomery County, N. Y., and went West in the gold rush of 1849. Mr. Birmingham made a fortune and became a banker in Marysville and later in San Francisco, and through his friendship with Gen. John C. Fremont acquired his interest in the Mariposa. He was the oldest member of California Lodge No. 1 of Masons, a Shriner and a member of the order of Masonic Veterans. He was married twice; his second wife and six children survive him.

Charles Martin Hall, inventor of the process of aluminum smelting which is now in general use, died at Daytona, Fla., Dec. 27, aged 51 years. Dr. Hall was born in Ohio and graduated from Oberlin College in 1885. He continued the study of chemistry, and in 1886 filed application for a patent on his process for making aluminum. His right to the patent was contested and it was not until 1893 that his prior right to the invention was finally established in the courts. In 1911 he was presented with the Perkin medal for his work in chemistry, and at that time a full account of his work was given. He began the commercial manufacture of aluminum with the Pittsburgh Reduction Co. in 1888, and since 1890 had been vice-president of what is now the Aluminum Company of America, its successor. Mr. Hall was a member of the American Philosophical Society, the American Institute of Mining Engineers, Franklin Institute and American Electro-Chemical Society, a trustee of Oberlin, member of several clubs and societies. He never married.

Col. Thomas Cruse, a pioneer of Montana and one of its most successful mine operators and business men, died at his home in Helena, Dec. 20, aged 79 years. Born in Ireland, he came to the United States when 20 years old and engaged in mining in California, Nevada, Idaho and Montana. In the '60s he located at Helena, engaging in placer mining in the summer and prospecting in the winter. On one of these trips he discovered the Drumlummon lode in the Marysville district. This he developed under circumstances that would have discouraged most men. At last he interested an English syndicate in the property. The mine was examined by the English people and was sold to them at a figure supposed to have been a million dollars. Colonel Cruse received in addition a large block of stock, which he later sold at a high figure. He never abandoned mining, investing his earnings in banking and ranching enterprises. Up to his death he operated successfully and profitably the Bald Mountain mine in the Marysville district and a mine in the Scratch Gravel district near Helena. He left an estate supposed to be worth several millions of dollars.

SOCIETIES

American Institute of Mining Engineers—The next meeting of the New York Section will be held Jan. 6, at the Machinery Club, 50 Church St. The meeting will be preceded by a dinner served at 6:30 p.m. Following the dinner Dr. L. D. Ricketts will open the discussion of "Problems in Leaching Copper Ores," in which a number of prominent members have already promised to take part. This will be a joint meeting with the American Electrochemical Society, and will be one of the most interesting meetings of the year.

TRADE CATALOGS

The Pelton Water Wheel Co., San Francisco, Calif. Catalog. Turbine and Tangential Water Wheels. 102 pp., illus., 6x9 inches.

Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill. Bulletin No. 34-S. Small Power Driven Compressors. 16 pp., illus., 6x9 inches.

Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Form No. 3024. Ingersoll-Rogler Valves for Air Compressing Cylinders. 28 pp., illus. 6x9 in. Form No. 3030. Class ER-1 Ingersoll-Rogler Air Compressors. 20 pp. Illus. 6x10 in.

Editorial Correspondence

SAN FRANCISCO—Dec. 23

The Argonaut Apex suit will not be reopened. The motion to that effect has been denied by Judge Wood in the superior court of Amador County. The suit of the Kennedy Extension Gold Mining Co. against the Argonaut Mining Co. was decided in favor of the Argonaut on June 29, 1914, when the court filed a written opinion as to the facts proved and the principles of law that he considered applicable thereto. In view of the geological conditions thus far revealed the court now thinks it not improbable that each side might continue indefinitely by additional work to make disclosures which it would deem corroborative to its theory. Neither side was hurried in the preparation for this trial. The court concludes, therefore, that "there must be a time even under the extreme latitude allowed in mining litigation when the opportunity to produce evidence at a trial must be closed against the litigant, and that time appears to have arrived in this case."

Natomas Consolidated bonds have been all deposited under the reorganization, except $155,500. Of this amount $95,000 is held in Belgium, Switzerland and France; the other $60,000 is scattered, its whereabouts not definitely known. The total number of bonds deposited represent $14,103,000. The new company will be formed about the first of the year to take over the old company. The levees of the two reclamation districts are expected to be completed by that time. They are said by the engineers to be safe from ordinary floods. About 80% of the agricultural land is leased and will be planted in barley and wheat. The company will receive 25% of the crop for the first year and 33⅓% of the crops for each of the next succeeding two years. The gold dredges in both the American River and the Feather River fields had good seasons. There were no new boats built during the year. Altogether the outlook for the success of the new organization is hopeful.

New Year Prospects look bright to mine owners and mine investors in California, and it is believed that 1915 will show an appreciable increase not only in gold production but in the production of other mineral substances. The report of the Selby Commission lends positive encouragement to copper miners, and it is now believed possible to smelt copper ores in California without being further harrassed by the farming element. The potash and magnesite industries should make an excellent showing in 1915. The only danger lies in the taking hold of such properties by irresponsible investors. There has recently been prospected a new magnesite deposit in Placer County which it is believed can be developed into a commercial undertaking. New potash deposits will be ready for development in San Bernardino County, and if the enterprise gets into the right kind of hands there is every reason to believe it will prove a commercial success. Dredge operators will probably meet with some opposition in the coming legislature, as there have been complaints of injury to streams by the outflow of water from the dredging ponds. Interference by the legislature will give opportunity for the California Metal Producers' Association to show its strength. There is no doubt that in some instances the operation of dredges should be more carefully regulated, just as it was at one time necessary to regulate the operation of smelting plants.

An Insurance Rate Reduction from 7.86% to 3.25%, obtained by the California Metal Producers' Association, is another good sign for 1915. Recent announcement of rates offered by the Industrial Accident Insurance Commission, made apparently on behalf of the commission, was misleading in that it ignored the lower rate secured by the Producers' Association. While the action of the state commission is commendable, it is quite probable that the old rate would have stood but for the activity of the metal producers.

When the California Metal Producers' Association met with the Industrial Accident Commission, Nov. 5, there was an apparent desire on the part of the commission to reach satisfactory terms with the mine operators regarding insurance. Subsequent to that meeting there were informal conferences between a committee from the commission and a committee from the association. In the beginning the commission was inclined to stand by the rate of 7.86 and decline all mining business. Later it apparently became convinced that the mining insurance business might be a good thing for the fund to handle; and a reduction was offered which would make an average rate of about 5½%. This offer was made on condition that the association would guarantee $100,000 in premiums. Shortly after that a reduction to 5% without the premium guarantee was offered.

The association continued its investigations and negotiations with various stock companies, and by offering the association business as a unit, or practically so, the members were given a rate of 3.25 flat, on unlimited risks covering all employees, regardless of the character of employment, whether underground, surface, mill or dredge. The announcement made on behalf of the commission was a rate of 5% for underground men, 2.79 for millmen, 4.8 for dredgemen, including the proposal to accept unlimited risks on this basis. Had the commission come out squarely in the beginning of these conferences and offered these last rates, it is not at all unlikely that the operators, acting through the association, would have accepted them and taken out insurance through the state fund. But the commission seemed in the beginning determined to maintain the high rate or demand a guarantee; and the apparent inference was that if the metal producers did not accept, then the high rate would stand in 1915, as in 1914, as a basis for stock companies to fix their rates upon. There is no doubt that if the metal producers had not organized the state rate would have remained the same and the stock companies would have continued charging high rates for mine risks.

This accomplishment of the Metal Producers' Association within less than two months after the organization was completed should attract the attention and appreciation of every mine owner and smelter in the state, and induce every operator and manager and owner who is not a member of the association promptly to come in and help to maintain an organization that evidently can be made of great and permanent benefit to the mining industry with proper support of men interested in mining and smelting. The association is sufficiently strong now to support itself and accomplish much for the industry as a whole and for mine owners as individuals, but the greatest good to the entire number will not result until the mine owners all over the state, irrespective of the class of mining engaged in, shall take part as members and workers. The association is not engaged in political reforms, nor has it anything to do with labor troubles. But it is considering and working for the best interests of the whole mining industry. Its membership includes practically all the deep gold mines, all the smelting plants, all the large dredges and a part of the hydraulic and the quicksilver mines. Within the first half of the year 1915 it is expected that every branch of metal production will be fully represented in the membership of the association.

DENVER—Dec. 24

Shut-Downs for the rest of the winter are faced by numerous mines on Breece and Iron Hills, in the Leadville district, because of a threatened famine in boiler-water supply. These properties all contain abundance of mine water but it cannot be utilized in the generation of steam because of its corrosive qualities. Hence they depend upon pure water derived from the Iron Hill ditch constructed in the early days of the district for placer-mining purposes. This season's severe cold weather accompanied by the absence of the normal snowfall, which ordinarily serves as a protective blanket over the ditch and its sources, has closed the ditch and frozen some of the pipelines leading therefrom to the mines. Among the prominent mines already affected is the Ibex (Little Jonny), operated now chiefly by lessees, and which closed—it is hoped but temporarily—Dec. 18.

Leadville Boosters are endeavoring to promote a coöperative local company having for its object the driving of an exploratory, transportation and drainage adit into Prospect Mountain, a prominence north of the main active part of the district and known to be composed of the same general geological series as prevails in the region surrounding the city and east of it. The project contemplates subscriptions calling for monthly cash installments of $10 per share for a period of years, all funds to be handled and expended by a party of influential business men who will act as directors of the corporation to the end of furthering the development of the district's resources and activities. Prospect Mountain has

been sufficiently prospected with surface work to warrant deep exploitation, for the best ore-bearing horizons lie comparatively deep.

The Cresson Strike is of interest not only on account of its great value but on account of its depth. A visit to the mine and a personal inspection of the bonanza impresses one tremendously. The occurrence of a large chamber of extremely high-grade ore at a depth of 1265 ft. below the surface is sure to inspire confidence in the deep-development possibilities in the district and will undoubtedly stimulate work on the lower levels of many Cripple Creek mines. Contributing influences are the recent favorable developments in the lower levels of the Vindicator and Golden Cycle properties, just over Bull Hill from the Cresson mine. The strike was made in the 12th level of the Cresson in the midst of the main oreshoot. A raise which was being driven as an ore pass from one of the crosscuts in the orebody on this level broke into a chamber almost full of rich ore thickly incrusted with crystals of quartz, strontianite and gold tellurides. The chamber is about 14 ft. wide, 23 ft. long and 36 ft. high. The present cavity is pear shaped and the ore pass enters it at a point a few feet above its present bottom. The full extent of the find has not yet been determined, but its extension downward will soon be learned by means of a crosscut driven to tap it at a point about 27 ft. below the 12th level. When first opened, the cavity had the appearance of a stope filled with broken ore. The filling consisted of fragments of breccia incrusted and permeated with crystals of sylvanite and calaverite. Most of this material could be mined with a pick. The telluride crystals were of two kinds; some were tabular, many over ¾ in. long, and many of these exposing a face having an area of more than ½ sq.in.; others were small and thick. Irregular deposits of crumbly, crystalline material thickly impregnated with telluride crystals formed the richest ore and assayed from $10,000 to $16,000 a ton. This material was carefully sacked, together with other fragments which were thickly encrusted with sylvanite. The balance of the chamber filling was shoveled over a 1-in. screen, the undersize assaying from $5000 to $6500, and the oversize running from $1000 to $1500. After the removal of the bulk of the filling above the chute opening, shots were put into the walls and all of the rock broken down was found filled with sylvanite crystals, as well as the walls from which the material was broken. The walls of the chamber show numerous small vugs lined with quartz and strontianite crystals and sylvanite or calaverite. The net value of the ore actually in sight may be conservatively estimated at not less than $500,000. In view of the fact that the extent of the deposit has not yet been determined it is probable that later development may justify a much higher valuation. The main oreshoot in which the rich chamber occurs is about 500 ft. long and has a maximum width of about 150 ft. on the 12th level. This shoot has been mined down from a point above the 6th level, but at the 12th level the width of the shoot suddenly increases from about 50 ft. to 150 ft. and the richest ore in the mine has been found in this level. The fact that the average value of the ore has increased with depth is a pleasing argument for those who favor deep development in the district. The Cresson is operated by the Cresson Consolidated Gold Mining & Milling Co. Most of the stock is owned by Chicago investors. The property lies in the gulch between Raven and Bull Hills. The mine has been efficiently managed for several years by Richard Roelof and its costs are probably the lowest in the Cripple Creek district.

BUTTE—Dec. 24

Labor Unions—Moyer, Miller and O'Brien commenced suit in the district court, Dec. 17, to oust the officers at present in charge of the affairs of Butte Miners' Union No. 1. These Federation officials allege extravagance and unnecessary expenditure of funds. The court is asked to issue a temporary restraining order prohibiting officers of the local from interfering in any way with Moyer and his representatives in the management of the business of the union. Argument was to have been heard before Judge Lynch, Dec. 21, but went over for a week, after a motion had been made to quash application.

SALT LAKE CITY—Dec. 24

A Mine-Rescue Car of the Bureau of Mines was in Tintic, Dec. 14-22. J. C. Roberts, in charge of the car, met the mine managers and superintendents on the evening of its arrival and gave an interesting talk, offering suggestions along the line of rescue work. Men from the different mines have been sent to the car and given instruction in the use of apparatus and in first-aid work. It is proposed to purchase apparatus and establish a rescue station in the district in charge of a competent man to be paid jointly by the mining companies. General interest was shown in the visit of the car.

SEATTLE—Dec. 23

A Big Strike reported from Candle Creek, a tributary of the Talalena which flows into the Takotna in the Koskokwim region, is responsible for a general movement to the district. The discovery was made on the Aitken & McKinnon property where a Keystone drill was working all last summer and last winter. There has also been a crew of 22 men working in an opencut at the timber line where the ground is only 6 or 7 ft. deep. The paystreak was found on the timber line and is said to be 150 ft. wide and getting wider as it goes down stream, being 480 ft. when the cold weather stopped drilling. The drill holes show an average of $7 to the square foot of bedrock along the left limit of the paystreak; 30 ft. from this rim the average is $6 and from there to the extreme right limit of the paystreak it gradually tapers off to 50c.

On the Upper Tanana, in Alaska, weather conditions hinder mining, according to reports received from all directions. Everywhere in the valley mining men are hoping for snow and sleighing in order that they may start hauling wood and supplies. On Healy River where pay was located last summer, several outfits have prepared for winter work, but will be unable to start until they get supplies. Lawrence & Albrecht who were on Tenderfoot have completed the work of constructing cabins, boiler houses and other buildings but will not start actual operations until snow flies. Josh Ray, Tom Maher and others who have taken property on Healy River will go to Fairbanks as soon as there is sleighing to get supplies so as to start work on a big scale. From the Tolovana, the Big Chena, the Bonnifield, the Kantishna, and other districts come complaints that operations and winter work are being held up for want of supplies.

The Matanuska Coal test results as made by the U. S. Cruiser "Maryland" were given to the public recently by Secretary Daniels and their favorable nature caused a great deal of comment in Alaska. It is believed that this removes any objection that might have been placed in the way of congressional appropriations for the railroad construction work. The only note of doubt in the secretary's memorandum to the committee on naval affairs is contained in the words, "and the results are so satisfactory as to justify the belief that the Matanuska coal is in all respects satisfactory for navy use, provided that the coal tested is a fair indication of the general character of the coal in that field." As against this is the statement given out in Seattle following the news of the report, by George Watkin Evans, consulting engineer, who was retained by the government as chief engineer of the expedition that went to the field last summer and brought out the coal to be tested. He stated recently that "the samples were taken at random and were merely screened without being handpicked. We made tests every day as the coal came down the chute and made no effort to pick out the best coal, because we were not there for that purpose." The test therefore ought to be a fair indication of the coal in the Matanuska field and on this score Alaskans have no fears.

WALLACE—Dec. 24

Shipments of ore and concentrates were 23,000 tons for November from the Cœur d'Alene district, about half the production for the corresponding month of 1913. The reduction in output is due to curtailment because of low metal prices. Most of the mines in the district have reduced their output, some as much 40%. Two of the important mines, the National Copper and the Morning, have closed.

In the Hypotheek mine near Kingston development of ore on the 900-ft. level is of importance because it assures the making of a valuable shipper outside of what had generally been considered the area of valuable deposits of the main Cœur d'Alene district. The mine is six miles west of Kellogg. The ore was found at the intersection of the crosscut with the vein, 180 ft. from the winze. The orebody was crosscut 10 ft., when the flow of water threatened to drown the pumps. Development has had to be suspended until a new pump can be installed. The ore assays from 6 to 30% lead, practically all of the lead being carbonate, an interesting occurrence, geologically, at a depth of 900 ft. below the surface.

HACKBERRY, ARIZ.—Dec. 23

Of the Several Mines in this district, the Copper Giant, since Sept. 28 the property of W. A. Clark, was shut down Oct. 6. It is opened by a 550-ft. shaft in the vein, with drifts on six levels. The work done so far shows the vein to be from 4 to 8 ft. wide, running about 2½% copper with $4 in gold. As soon as financial conditions improve it is proposed to sink to 1000 ft. and probably to install an electric power plant at the railroad. The property is in charge of William Neagle. The Walkover mine, for a time under option to Qualey Bros., is now working with a small force. The ore averages about $30 in gold, but the copper content is increasing with depth. The old Hackberry mine, which in

its time produced over $3,000,000 in silver, is under option to Qualey Bros. A vertical shaft was sunk to strike the vein below the old workings, but was not successful, there being no old mine maps giving the necessary data. The shaft was full of water for over two months, but finally, after the installation of a pump and compressor, work proceeded once more. At latest reports the shaft had just broken into the old workings. D. F. Noehl is in charge. The Nevada-Arizona Mining Co. is proceeding with its work at Music Mountain. A good deal of gold ore has been developed. The mill is being enlarged, and a seven-mile pipe line will furnish enough water for the milling operations.

COURTLAND, ARIZ.—Dec. 23

In the Courtland-Gleeson district all the properties are shut down. Some leases are being worked for high-grade copper ore on the properties of the Great Western Copper Co., and of the Calumet & Arizona Mining Co., the ore being shipped to Douglas. Both of these properties are exhausted except for small high-grade copper bodies, and the prospects for the future are not bright. At Gleeson the suspension of operations is entirely due to the shut-down of the Shannon Copper Co., following the demoralization of the market. It seems probable that work on the low-grade cupriferous sulphide bodies will be resumed when normal conditions return.

DULUTH—Dec. 26

The M. A. Hanna contract for Great Northern ore provides for the sale of all ore except that from the Dean mine, which will be operated by Tod-Stambaugh. The total available product for 1915 will be about 3,000,000 tons. An official estimate of the ore in these lands made early in 1914 was 411,449,154 tons. During the time the lands were controlled by the Steel Corporation, it expended about $6,000,000 in development and mined approximately 20,500,000 tons.

HOUGHTON—Dec. 26

Copper Shipments by way of the Great Lakes, from April until the close of navigation, Nov. 18, showed a total of 107,866,000 lb. This can safely be placed as the figure of copper output during the open summer, as practically no copper went by rail this year. This total is divided by ports as follows: Houghton, 17,514 tons; Hancock, 5329; Dollar Bay, 11,260; Torch Lake, 19,830; total, 53,933 tons. In addition to these shipments from Michigan ports 11,122 tons of Western copper passed through the Michigan waterways. This was largely Butte copper on its way from Montana to the Eastern markets, taking advantage of the lower rate by water. Included in the totals given was one shipment of Western copper, 101 tons of electrolytic, that came to Dollar Bay for retreatment and was later shipped to the Eastern markets.

CRYSTAL FALLS—Dec. 26

Prospecting or Exploratory work in Iron County during 1914 was at a low ebb. Several shallow diamond-drill holes were put down on the S. ½ of the N.E. ¼ of Sec. 30—43—32 by a combination of Minnesota interests. This work showed a strong ore formation and disclosed the location of the slate walls, but none of it was carried to sufficient depth to prove the value of this property. The option was thrown up and after six months' time had elapsed the Cole & McDonald Exploration Co., of Duluth, took up the option on its own behalf to drill at depth. This drilling now going on has not progressed far enough to prove or disprove the value of this property.

The Bristol Mining Co., of Ogleby-Norton, recently took options on an extensive area of land west of the Bristol mine in sections 24, 25 and 26, and started test-pit work, together with some churn drilling. The churn drills succeeded in locating the ore formation, and it is of so promising a nature that two diamond drills are now employed, as well as five churn drills. Results are said to be pleasing to the Bristol officials, but no definite information is given out.

The E. J. Longyear Co., of Minneapolis, has been working three outfits, churn and diamond drills steadily during the year on the south half of sections 27 and 28—43—34, lying east of the Rogers mine. The company encountered a heavy surface burden said to go down 300 ft. and more to ledge. Much formation has been shown, but so far as known no ore concentration has been found. This territory is good, as a large ore-basin has been proved by diamond drilling and by the opening of the Rogers mine on section 29, but the surface burden is uniformly heavy and the cost of work necessarily high on that account. On the other hand, the ore has been shown to extend to a depth of 1700 ft.

The St. Clair Exploration Co. did a little diamond-drilling upon the S. ½ of the N.E. ¼ of Sec. 26—43—35, just south of the Chicago & North Western station. It is reported some ore was cut and an important ore formation shown. In addition to surface drilling, underground drilling has been done and also check drilling, notably by the Verona Mining Co., as previously noted in the "Journal."

ST. JOHNS, NEWFOUNDLAND—Dec. 5

Mining on this island, England's oldest colony, is, of course, at a low ebb on account of the war; but there are indications of a revival to come, not only in iron and copper, the two principal ore exports, but also in the other minerals in which the island is rich, but which have lain nearly as undeveloped as when, in 1497, John Cabot was paid £10 by the King of England for discovering the country.

On Bell Island in Conception Bay, not far from St. Johns, the Nova Scotia Steel & Coal Co.'s iron mines are temporarily closed, throwing some hundreds of men out of employment, while the Dominion Iron & Steel Co. is employing a greatly reduced crew working the extensive tracts purchased from the Nova Scotia company for $1,000,000 in 1898. The Nova Scotia company had been shipping much ore to Rotterdam for German consumption, previous to the war, and some of the ore undoubtedly went to make Germany's guns and warships; it has also shipped extensively to Middlesboro, England, and to Philadelphia, as well as to its own furnaces near its coal mines at North Sydney, N. S. Bell Island iron ore, much of which is mined in submarine areas from strata underlying Conception Bay, runs about 50% in iron and possesses the advantage of being a hard, blocky ore well liked for furnace mixtures; a good deal of it occurs in square blocks of the size and shape of bricks. Bell Island, a windy, rocky island, six miles by two, has been elaborately fitted up with modern ore-loading piers, tramways, power houses, and mine machinery by the two companies, and is destined to be a factor in the iron-ore market for years to come. Many million tons are known to exist in the extensive beds under the ocean, occurring in three or four seams varying up to 30 ft. in thickness.

In Notre Dame Bay, farther north on the Newfoundland coast, and off the railroad, is the copper area. Here, at Tilt Cove, Bets Cove, Little Bay, etc., copper has been mined for 50 years. In recent years, however, the English company operating in this area has abandoned the mines and transferred its operations to copper deposits at Bay Verte, 30 or 40 miles up the coast, where promising results are being obtained, although not so large forces are employed as formerly at Tilt Cove. The Tilt Cove mines have reverted to the original owners who are continuing to take out ore where it can be found. The English company, the Cape Copper Co., operated here for a number of years, profitably for the most part, although considerable money was lost in attempting to smelt the ore on the ground instead of shipping it to England. The smelting works were unsuccessful, as the ore requires fluxing.

The Pyrites Mines on Pilley's Island, also in Notre Dame Bay, at one time worked on a large scale by American operators, are now closed and full of water. The oil drilling project at Parsons Pond on the sparsely settled west coast of Newfoundland, about which considerable was heard several years ago when a British company started drilling, has died out temporarily at least, although it is known that oil occurs in that area. Nothing has ever been done in a commercial way to develop the known areas of coal seams in western Newfoundland, which are bound to become important factors in the economic growth of the island. For mining operations along Newfoundland's extensive coast line, coal can be brought from Sydney fairly conveniently in steamers or schooners; from Sydney to St. Johns is about 400 miles by water, while it is only 100 miles from Sydney to Port-aux-Basques situated in the southwest corner of the island.

LLALLAGUA, BOLIVIA—Nov. 19

Conditions in Bolivia are at present anything but good. Since the beginning of the war exchange has dropped from over 19 pence to 14 to the boliviano, and business is practically at a standstill. Work on nearly all railroad and development contracts has been stopped and wages for labor have dropped to less than half the figure paid before the war. As it is impossible to sell tin concentrates except in extremely small lots and at low prices, most of the small tin mines have closed down and the larger producers are practicing every possible economy. There is one small smelting plant in Bolivia which is understood to be working at capacity and finding a ready market for its products. It is believed here that someone in the near future must see the advantage of erecting a tin-smelting plant in the United States to handle the Bolivian concentrates. Nothing could be more welcome to the Bolivian miners.

The Mining News

ALASKA

FAIRBANKS YIELD $3,500,000 according to estimates of Wells Fargo for 1914. Total of 174,646½ oz., valued at $3,109,072 shipped by express to States. Compares with shipments of $3,639,899 during 1913. Hot Springs district shipped $200,000 direct this summer. Most of Ruby output also went direct instead of through Fairbanks. Believed private shipments by mail and carrier would make Fairbanks output about same as last year.

MINERAL CREEK promises to be big producer; largest operators, Clifford Philips and associates own 30 claims stretching for four and a half miles from cañon toward head of river, have completed annual assessment work and during summer did considerable prospecting including 600 ft. of open-cut work. Panning in cuts gave good indications but water and lack of machinery prevented reaching bedrock. They will put Keystone drills on property early in spring to reach bedrock and if present indications are fulfilled machinery will be placed on ground.

INDEPENDENCE (Knik)—New mill, probably Lane, will be established on property early in spring.

MASCOT BENCH (Ruby)—Pay on this property where the big nugget was recently found still grows richer; stated miners are now working in ground which goes over $25 to the foot.

MOTHER LODE COPPER (Shushanna Junction)—Company reports finding new vein intersecting Marvelous vein, appears to carry large shoot of high-grade ore. Superintendent Parks expects to ship out 1000 tons during coming season.

WASHINGTON ALASKA GOLD MINING CO. (Valdez)—Long tunnel tapped ore at 200 ft. below surface outcrops. Vein varies from 4 to 5 ft. and said to assay $32 per ton. Work will be continued all winter with view of putting mill on the ground early next spring. B. C. Wiltze manager.

VALPARAISO (Ketchikan)—Work of driving drainage tunnel progressing rapidly and will be kept up as long as weather permits use of water in compressing air. About 500 ft. remains to be driven, and expectations are it will be completed early in spring, when work of getting out ore can proceed. B. A. Eardley manager.

JUALIN (Jualin)—Work on this property north of Juneau to be resumed soon according to reports. Capital for work largely Belgian and shut-down came shortly after announcement of war, although $1,000,000 had been subscribed for development work. With property resuming practically 100 men will be put back to work.

ARIZONA

Santa Cruz County

ELEPHANT'S HEAD (Amado)—Shut down until financial situation is more encouraging.

MORNING GLORY (Patagonia)—Chris. Wilson, owner of this shipping mine, negotiating sale to smelting men. Examination by probable buyers was satisfactory.

CONQUEST (Tubac)—Attempt made to sink shaft on this vein, but at 20 ft. water prevented further sinking, though vein showed 4 ft. solid of copper sulphide ore. Pumps will be installed to handle water and shaft sunk as long as ore holds good. Mine in Agua Caliente water basin on limestone contact; thought there will be serious difficulty in unwatering.

SONOITA COPPER CO. (Patagonia)—This company composed of A. L. Harroun and Kansas City people now opening old Bradford mine on Sonoita Creek below Patagonia. Mine has shipped some copper ore. Company will also sink shaft on the famous Salero mine in near future; this shaft now 400 ft. deep; planned to carry it to 600-ft. level. A. E. Swain manager

Yavapai County

ARIZONA POWER company has extended service to smelting plant of United Verde at Clarkdale. Other extensions contemplated.

CALIFORNIA

Amador County

PLYMOUTH CONSOLIDATED (Plymouth)—Last cleanup report shows 9000 tons treated; total recovery $44,100. Net earning said to be $20,899. Large high-grade reserves blocked out. Plans for deepening shaft and opening up new ground delayed by war. Sufficient ore reserve to continue extraction and treatment. Erection of hospital contemplated.

Calaveras County

BOSTON (Mokelumne Hill)—Reported that sale is under negotiation and that mine will be reopened.

NUNER (Mokelumne Hill)—Mill running on pay gravel and prospect said to be good for further developments.

BREUSTER (Mokelumne Hill)—This gravel mine in Chile Gulch will resume operation under new management.

Kern County

PEARL-ZENDA (Amalie)—Reported property sold to Phelps-Dodge interests. Mine equipped with 10 stamps, tube mill and 50-ton cyanide plant.

KERN PLACER MINING CO. has purchased 12 placer claims in Last Chance, of Charles Koehn, of Koehn Springs. Reported special machinery will be installed by M. P. Boag, of San Francisco. Sufficient water found at depth of 14 ft.

Nevada County

CHAMPION (Nevada City)—Large amount expended in development by North Star and property now in position to resume production. Cleanup of mill for November reported at $35,000.

EMPIRE (Grass Valley)—New orebody encountered by crosscut from 3400-ft. level into Pennsylvania mine. Believed to be rich shoot encountered in Pennsylvania at higher level, which has yielded large amount since Pennsylvania was taken over by Empire. Purchase price of Pennsylvania said to be $500,000; reported this amount already taken out, although final payment is not due until spring of 1916.

Plumas County

HYDRAULIC mining on Willows Creek near Buck's Ranch reported by G. W. Fagg to have been successful in past season. Water supply sufficient for extensive operation; he predicts better season in 1915, owing to heavy snows of present winter.

Siskiyou County

H. A. BALL, of Etna, will reopen old George hydraulic claim at Shaddick Creek.

Tuolumne County

HOPE (Sonora)—Five-stamp mill installed recently crushing ore of higher grade than previously and result warrants continuance of development.

MAZZEPA (Jamestown)—New ground to be prospected and this old property reopened. If development warrants, operation of mine will follow.

MONTEZUMA (Jamestown)—Reported C. F. Montgomery, of San Francisco, has begun reopening of this property on west side of Table Mountain.

NORTH STAR (Sonora)—This property, which adjoins Carlotta on north, being unwatered preparatory to development by Eastern men who hold it under bond.

MANGANTE (Jamestown)—Ten-stamp mill and other surface equipment of Mountain Boy mine near Columbia purchased and removed to this property where it can be utilized by both Mangante and Carlin mines.

REPUBLICAN (Sonora)—New results indicate mine can be kept going and contemplated shutdown of mill will be necessary only for repairs. Mine formerly large producer, although depth only 700 ft. Drifts run both ways from five levels. Vein matter about 16 ft. wide carrying fairly good grade of ore. Mine reopened about two years ago and present indications are it will again be listed among producers.

COLORADO

Boulder County

TUNGSTEN mining slowly resuming in the Nederland region although miners expect to hold concentrate until market price advances materially.

HIGHLAND MARY (Hesse, via Eldora)—Work will soon resume in driving deep crosscut adit now in 2000 ft. with 90 ft. of drifts. Several lodes disclosed and will be explored. Altitude of property warrants method of development.

Clear Creek County

STANLEY (Idaho Springs)—Thomas Eagan overhauling Salisbury mill preparatory to treatment of ore he will mine under new lease.

AMAZON (Empire)—Donald Bristol has taken superintendency of this property recently purchased by Denver people and has men taking out lead-silver ore to be shipped crude. Another grade will be concentrated in Silver Mountain mill.

Lake County

MANGANESE ore being shipped by George Cramer, making 65% concentrate for market to replace high grade formerly imported from Germany. Prevailing prices, however, not encouraging.

LAKE COUNTY METAL MINERS' ASSOCIATION has been holding meetings and inaugurating several measures expected to increase activity in district as well as throughout state. Has drafted bill to be urged at coming season of legislature demanding inclosure on surface of abandoned shafts and pits as well as shaft stations in underground workings. Has instructed county's legislators on its views regarding equitable mine taxation. Attempt being made to induce mine owners to grant lessees more favorable royalties. Association favors establishment of U. S. metallurgical testing plant in Denver instead of in Salt Lake City, as proposed. Desires stipulations be made in biennial appropriation to Colorado School of Mines, making it obligatory on school to make free assays and treatment tests upon Colorado ores.

Park County

LONDON (Alma)—Still another sublease has been let, this one being to George W. Casey and John Nelson, of Leadville. Entire mine divided into lease blocks eagerly sought by Leadville miners. Ultimately some project must be financed for developing and draining to greater depth. Orebodies abandoned only because of water difficulties.

San Juan County

SILVER LEDGE (Chattanooga)—Lessee Louis Bonavida has repaired aërial tramway destroyed two winters ago, has

remodeled mill and is prepared to mill ore from large shoot he struck on fourth level.

SILVER LAKE (Silverton)—Lessees working through Unity tunnel, making shipments of lead-copper ore, propose to drive inclined raise during winter to facilitate handling ore which now must go through series of raises and levels to reach adit.

San Miguel County

SUFFOLK (Ophir)—Jurich & Vukovas have fitted up 10 stamps and air compressor in mill, preparatory to operation of lease.

Summit County

JUNIATTA (Breckenridge)—Cumbre Mining Co., C. Lorimer Colburn manager, recently unwatered this Nigger Hill mine and made first carload shipment of zinc-sulphide ore.

IDAHO

HORST-POWELL (Little North Fork)—Bonded to Alfred Page, of Wardner, for $50,000.

MARSH (Burke)—Granted rehearing before public utilities commission in case against Washington Water Power Co., regarding electric power rate discrimination.

MICHIGAN

Copper

ISLE ROYALE (Houghton)—Mill burned to ground Christmas Eve, loss $250,000. Will not be rebuilt. Rock from mine will go to Centennial-Allouez mill for time being. Was only mill on Portage Lake and employed 100 hands. If new mill is built will be at some other place, as government has been objecting to dumping of stamp sands in lake and has placed limit beyond which point sands cannot be dumped. Isle Royale is C. & H. company.

PORCUPINE (Ontonagon)—Interest increases in Porcupine explorations, on the S. L. Smith property, Sect. 7, 10 miles west of White Pine, on same lode. W. Bolley, recently resigned as superintendent of Baltic mine, in charge of operations. Years ago exploring was carried on at this point but consisted simply of test pits and was not thorough. In no case was formation tapped, sinking carried through overburden only. In present effort formation uncovered for 85 ft. For whole distance Nonesuch lode opened and found healthy. Distance between Nos. 1 and 2 veins never found more than 8 in. Shaft down 45 ft. Primitive methods used as yet; sinking only 2 ft. a shift; drilling by hand; hoisting with windlass. At 45 ft. vein dips at an angle of 80°. In White Pine and Nonesuch properties lode much flatter. Surface equipment at Porcupine simple. Building consists of shaft house in which is also smithy. Bunk house provided for workmen. Rock so far taken out contains both copper and silver.

WHITE PINE (Ontonagon)—Calumet & Hecla's total outlay in opening this property will be close to $2,000,000. Operations include underground development and completion of stamp mill. Fourteen machine drills at work in three shafts. Nos. 3 and 4, permanent shafts. No. 3 down 1100 ft.; four levels cut; hoisting confined to rock from second level; shaft running through good copper ground, better than any so far opened on Nonesuch lode. Shaft house in course of erection at No. 3. Engine- and boiler-house being built; will house Lake Shore engine having 10-ft. drum, and three boilers which will supply steam for No. 4 engine similar in type to No. 3. No. 4 shaft down 1200 ft.; hoisting from second level; rock showing better than average commercial copper. Shaft house to be constructed here soon. At both shafts there is considerable stockpile. No. 1 shaft simply exploratory and at depth of 120 ft. company raised what is now No. 4. No. 2 shaft near original White Pine shaft; work carried on in this old shaft. Copper rock also being hoisted at No. 2 but not so fast as at Nos. 3 and 4. Work on other buildings going ahead satisfactorily. Exterior work on boiler house and stamp mill finished. Crushing plant nearing completion. Forms being set for compressor and steam-turbine plant. This will accommodate six boilers. Trestle 800-ft., will take care of rock from Nos. 3 and 4 shafts. There will be no rock crushers in shaft houses. All rock will be crushed in separate plant, to which it will be carried over trestle. Conveyor belt will take care of crushed rock from plant to mill.

Iron

STEPHENSON CHARCOAL IRON CO. (Wells)—Furnace will go into blast again first of year, after idleness of several months. Orders received for pig iron, encouraging news for iron district.

IRON MOUNTAIN LAKE (Ishpeming)—This mine of Jones & Laughlin, in process of development, has had to be closed because heavy flow of water was encountered that pumps could not handle. Shaft is short distance from Ogden Lake and it is believed water course connected with lake was tapped. Shaft filled to within 50 ft. of surface in comparatively short time. Pumps now being taken to mine and work of removing water will be started as soon as possible.

MINNESOTA

Cuyuna Range

ROWE (Riverton)—Hydraulicking and steam-shovel work stopped.

KENNEDY (Cuyuna)—Recently inspected by Cleveland-Cliffs officials and engineers, with view to taking over, it is said.

BARROWS MINING CO. (Barrows)—Good ore shown up in village; company states will sink steel and concrete shaft in spring.

ARMOUR (Crosby)—Stated, but not authoritatively, that Inland Steel is negotiating for Nos. 1 and 2, adjoining Thompson mine of Inland Steel.

BRAINERD-CUYUNA (Brainerd)—Latest shaft, third attempt, now through most difficult section of quicksand; should reach ledge without further difficulty.

WILCOX (Brainerd)—Additional pumping equipment has enabled mine to about clear itself of water. Additional tonnage developed in vicinity recently by E. J. Longyear Co.

DULUTH-BRAINERD (Ironton)—Eastern interests requested and received 30-day extension of option. Property idle but has shaft in manganiferous iron ore ready to produce.

Mesabi Range

HILL ANNEX (Calumet)—About 400 men employed by Guthrie & Co., having contract to remove approximately 8,500,000 cu.yd. of overburden from orebody. Job will take four years. Stripping being dumped on 280-acre tract 1½ miles distant from operation.

MONTANA

Silver Bow County

BULLWHACKER (Butte)—Reported from Spokane that large number of shareholders had come in under the reorganization plan and taken new stock.

NEVADA

Esmeralda County

JUMBO EXTENSION (Goldfield)—Drifting on deepest level in ore assaying $150 to $300. Daily shipments 100 tons $100 ore.

Humboldt County

SATAR PEAK (Rochester)—Small mill running. Mining method unique; about an acre of ground plowed and scraped, disintegrated rock milled at profit. Stated larger mill will be built next spring.

Nye County

BULLFROG MINING SYNDICATE (Pioneer)—Operations will be resumed immediately. Property east of Pioneer Consolidated, fully equipped for work on large scale.

Storey County

CROWN POINT-BELCHER (Virginia City)—Fire of unknown origin reported discovered on 1500 station of joint incline evening of Dec. 20. Bulkheads placed in incline below 1400. Pumps in incline sump shut down, allowing water to rise and preventing spread of fire down incline or to 1600 level of Belcher. No trouble expected in holding fire to small area. After discovery, hose line laid, but heat too great to permit fighting. Same result followed trial of helmets. Bulkheads therefore built. Direction of ventilation prevented rapid spread of fire up incline. Incline used for pumping. Latest advices give conditions much improved.

NEW MEXICO

Grant County

SAVANNA COPPER CO.—Company offering full paid shares at $1 in ratio of one to 20 of present holdings of stockholders of record as of Dec. 30, 1914. Company owns several thousand acres of patented ground in Burro Mountain district, but has been inactive for several years..

Sierra County

ILLINOIS AND SARATOGA (Kingston)—According to court records these mines sold to C. T. Brown, southwestern representative of Empire Zinc, for $5000. Illinois mine produced large quantity of silver in early days.

OREGON

STATE LAND BOARD accepted bid of Jason Moore & Co., of New York, for lease of Abert and Summer Lakes in Lake County on royalty basis for all minerals that may be abstracted from waters. Lease made for 45 years, subject to approval of legislature. Moore & Co. plans to establish plant to cost $6,000,000 at junction of Deschutes and Columbia Rivers and pipe line 260 miles along Deschutes River to be used in transferring product to plant. Bid accompanied by certified check for $10,000, conformed with requirements for tenders and offered state following royalties on products to be secured by evaporation of waters: Potassium salts, 50c. per ton; sodium chloride, 10c.; other salts, 25c. Bid of Oregon Soda & Potash Mining Co. not accompanied by any check nor was it in accordance with other requirements.

SOUTH DAKOTA

LAWRENCE COUNTY in which are situated Deadwood, Lead, Terry, and principal mining centers of the Black Hills, during present year expended $75,000 in road improvement. All work under supervision of competent engineer. Light gradients being adhered to; all bridges of steel, with concrete abutments. Present work of permanent character and of much benefit to mining industry.

UTAH

Juab County

CHIEF CONSOLIDATED (Eureka)—Ore shipments cut down from about 25 cars weekly to seven or eight, awaiting better metal market. Promising breaks such as may lead into new orebodies being followed, instead of mining ore already opened. Much interest taken in fact that Chief has optioned Scotia. Business of Chief so well advanced, as far as the original undertaking is concerned, as to permit of expansion in way of taking over additional properties. Careful examination convinced the management Scotia offered good fighting chance. Sinking on ore started, following completion of construction work and installation of equipment.

Salt Lake County

UTAH METAL & TUNNEL (Bingham)—This company, formerly Utah Metal, reorganized and financed. Compressor plant overhauled, and put in good condition. Development started; drifting being done from main drainage tunnel about 3000 ft. from the Carr Fork end. Some mineralization encountered.

CANADA

Yukon

SEASON CLOSED Dec. 16, when Boyle dredge No. 4, put up for winter at mouth of Bonanza. Boyle No. 2, which sank two months ago partly raised; work on her will begin before spring.

The Market Report

Metal Markets

NEW YORK—Dec. 29

Copper, lead and spelter again experienced a week of excessive dullness and exhibited further softening in prices, but the recessions were not material.

Copper, Tin, Lead and Zinc

Copper—The market was again dull during our last week of record, but the volume of the business was distinctly greater than in the previous week, first hands having played more of a part in the market, a distinct disposition to take what business was offered, even at reduced prices, having been manifested in certain quarters. The business so taken amounted to several millions of pounds, being done at about 12⅞c., regular terms. Other producers, however, stood quite aloof, neither courting business at concessions in price nor holding out for any fixed price, but awaiting the reäppearance of demand in such volume as would make negotiations worth while.

Copper sheets, base price is now 18½c. per lb. for hot rolled and 19½c. per lb. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire 14@14½c. per lb., carload lots at mill.

Copper exports from New York for the week ended Dec. 19 were 14,862,158 lb. Copper imports for the week ended Dec. 23 included 365 long tons of metal and 330 tons of matte.

Exports from Baltimore for the week ended Nov. 28 included 1,736,771 lb. copper, 1,121,016 lb. lead and 448,600 lb. spelter, all to Liverpool.

W. Parsons Todd, 32 Broadway, New York, becomes selling agent for the Copper Range Consolidated Copper Co., whose output has heretofore been sold by the United Metals Selling Co.

Brass Prices, base, were advanced about ½c. per lb. by the American Brass Co. on Dec. 22, and are now as follows: Sheets, high brass, 15c. net per lb.; low brass, 16⅝c. Wire, high brass, 14¾c.; low brass, 16⅝c. Rods, high brass, 14¾c.; low brass, 17⅜c. Tubes, brazed, 18¾c.; open seam, 18¾c. Angles and channels, 18¾c. Scrap allowances are 9½c. net per lb. for high brass; 10⅝c. for low brass.

Tin—In sympathy with the advance on the London Exchange on Dec. 24, prices in this market became a shade firmer, but buyers refused to become interested and business continued stagnant. The market closes entirely nominal.

Lead—This market also exhibited a softer tone, domestic demand being insignificant while foreign buying was not so large as it has been. However, the demand from abroad continues and is the mainstay of the market. In the St. Louis market the price level is beneath that of the A. S. & R. Co., and the price of the latter has also been undercut in the Chicago market, but in the New York market business remains steady at 3.80c. Sales for export from New York, however, are reported at prices figured as netting a few points both above and below that figure.

Spelter—The situation in this metal remained substantially unchanged. Sales of a few hundred tons daily were reported, both for home and foreign consumption, but the aggregate was not large. Domestic consumers generally continue to be conspicuous by their absence.

Zinc sheets, base price, $8.75 per 100 lb. f.o.b. La Salle, Ill., less 8% discount. Usual extras charged.

Recent reports from Belgium are to the effect that none of the zinc-smelting works along the Meuse were injured but all of them are idle. The plants in the Campine district are operating, but on a reduced scale.

Other Metals

Aluminum is reported rather firmer, with more inquiry. Contracts for 1915 delivery are being closed at about current prices. Quotations are a trifle firmer at 19@19¼c. per lb. for No. 1 ingots, New York.—In **Antimony** some demand for export is noted, but domestic business is rather flat. Spot is firmer in price than futures. Ordinary brands are quoted at 13½@14c. per lb., New York. Some Hallett's is to be had at 16½c.; while 16@17c. per lb. is asked for Cookson's.—**Quicksilver** has been quiet and is dull and unchanged in price at $50 per flask of 75 lb., New York. London price is £11 5s. per flask.—**Nickel**—Ordinary forms—shot, blocks or plaquettes—are 40@45c. per lb., according to size and terms of order. Electrolytic metal is 5c. per lb. higher.

Exports and Imports of Secondary Metallic Products in the United States, 10 months ended Oct. 31, in pounds:

	Exports		Imports	
	1913	1914	1913	1914
Copper sulphate	3,845,455	7,231,183	.....	.....
White lead	12,837,527	15,287,767	.....	.....
Zinc oxide	25,660,635	26,481,061	.....	.....
Zinc dust	156,656	190,792	3,822,572	3,526,382
Zinc dross	56,696	3,415,314	.....	.....

Exports include reëxports of foreign material. Domestic zinc ore exported, contents not given, was 14,398 tons in 1913, and 8499 tons in 1914; decrease, 5899 tons.

DAILY PRICES OF METALS IN NEW YORK

Dec.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Cts. per Lb.	New York, Cts. per Lb.	St. Louis Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
24	4.8600	48¾	12.65 @12.75	33½	3.80	3.60 @3.65	5.55 @5.60	5.40
25	.....	...	.....	...	....	.....	.....	.....
26	4.8500	48¾	12.65 @12.75	33½	3.80	3.60 @3.62½	5.55 @5 60	5.40
28	4.8500	48¾	12.65 @12.75	33¾	3.80	3.60 @3.62½	5.52½ @5.57½	5.35 @5.40
29	4.8500	48⅞	12.65 @12.75	33½	3.80	3.60 @3.62½	5.52½ @5.57½	5.35 @5.40
30	4.8500	48⅞	12.65 @12.75	33½	3.80	3.60 @3 62½	5.55 @5.60	5.40

The quotations herein are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumer, and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Dec.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
		£ per Ton	Cts. per Lb.								
24	22 11/16	56¾	12.78	57	*	148	145	19¼	4.16	26⅞	5.84
25	...	...	.....	...	*	....	....	..	....	...	....
26	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	22 11/16	56⅛	12.75	57	*	148½	145¾	19	4.13	26⅜	5.78
29	22¾	56¼	12.78	57⅛	62	148½	146	19	4.13	27¼	5.92
30	22¾	56⅛	12.75	57	*	147¾	143¾	19¼	4.16	27½	5.97

*No quotations.

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26¼c; £20 = 4.35c.; £30 = 6.52c.; £60 = 13.05c. Variations, £1 = 0.21¾c.

Gold, Silver and Platinum

Gold—Exports of gold from New York have been on a limited scale, compared with recent weeks.

Gold output of Rhodesia in November was 74,869 oz., or 6296 oz. less than in October. For the 11 months ended Nov. 30 the total was $12,992,108 in 1914, and $16,218,695 in 1914; an increase of $3,226,587, or 24.8%. The 1914 production was the largest ever reported.

Platinum—The market has remained quiet on a limited demand. There is very little doing and sales have been few. Quotations are $41@42 per oz. for refined platinum. Hard metal is $46@49 per oz., according to grade.

Silver—The undertone of the market continues good, with orders from London, apparently for other purchasers than the English Mint, which has been the chief factor in sustaining the price. It is possible the buying may be on China account, but at this writing the information is not at hand to indicate the buyer.

Zinc and Lead Ore Markets

JOPLIN, MO.—Dec. 26

Blende, high price $54; assay base, $49@52; metal base, $47@48; calamine base, $23.50@27.50; average, all grades of zinc, $45.22 per ton.

Lead, high price, $48.50; base $47 per ton 80% metal content; average, all grades of lead, $47.12 per ton.

Mill owners are endeavoring to operate more steadily and some are making an effort to double shift work in the ground, but so far these efforts have been of small avail. It is hard to find miners for the additional work, and continued cold, severe for this locality, prevents an increase. And on the other hand the production of calamine and lead is greatly retarded by the weather. The result is that production is decreased in the face of all efforts to increase it.

SHIPMENTS WEEK ENDED DEC. 26

	Blende	Calamine	Lead	Values
Totals this week....	8,987,270	1,442,740	826,850	$255,350
1914 totals.....	510,803,020	39,031,810	87,523,250	12,819,030

Blende value, the week, $216,120; the year, $10,333,710.

Calamine value, the week, $19,760; the year, $463,390.

Lead value, the week, $19,470; the year, $2,041,580.

PLATTEVILLE, WIS.—Dec. 26

The base price paid this week for high-grade zinc ore was $50@51 per ton. The base price paid for 80% lead ore was $45@46 per ton.

SHIPMENTS WEEK ENDED DEC. 26

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	2,884,530	121,400	329,700
Year	166,656,300	5,120,290	31,751,550

Shipped during week to separating plants, 3,104,230 lb. zinc ore.

The year to date shipment of net zinc ore to smelteries exceeds that of 1913 by 7316 tons, while the gross shipment of zinc ore from mines to smelteries and to custom roasters exceeds the total of 1913 by 26,076 tons.

Iron Trade Review

NEW YORK—Dec. 29

The better feeling in the iron and steel markets continues to hold, and it is now being backed up by an increase in orders. The announcement that the Steel Corporation would not cut wages had a favorable effect, and served to steady prices and bring out buyers who had been looking for lower prices with lower wages.

Some heavy foreign orders for barbed wire are under negotiation at Pittsburgh, and other material for export is also being inquired after.

More pig-iron sales are reported, chiefly foundry and basic. There has also been some inquiry for low phosphorus pig, chiefly in the East.

PITTSBURGH—Dec. 29

The advent of the holidays has only slightly reduced the volume of buying in steel products, there being still a much heavier movement than a month or six weeks ago, both in actual orders and in contracts calling for specifications during the first quarter of the new year. The activity is fairly well distributed among the different finished steel products.

There is somewhat increased railroad inquiry but as yet there is no business of importance traceable to the favorable decision in the eastern rate case rendered Dec. 18. Other buyers, however, appear to have been encouraged by the decision.

Lately the mills have been quoting 1.05c. for immediate specification and prompt shipment for bars, plates and shapes, quoting 1.10c. on contracts involving specification during the first quarter. Some have now withdrawn the 1.05c. price for prompt shipment and others will do so Dec. 31, leaving the market at 1.10c. as minimum. Later an advance is probable to 1.15c. as a strategic move, to induce specifying on the contracts written at a lower price.

A decided increase in the rate of steel-mill operations is expected immediately after the first of the year, to about 50% of capacity.

The general feeling in the steel trade is now decidedly hopeful, on the ground that the whole steel market has now undergone a turn for the better, and that with easy money and other favorable influences the improvement should be more or less continuous.

Pig Iron—The market has been rather quiet locally, but with a fair run of small orders for foundry iron. Prices are well maintained. We continue to quote: Bessemer, $13.75; basic, $12.50; No. 2 foundry and malleable, $12.75@13; gray forge, $12.50@12.75, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—There is nothing new in the situation, and prompt and contract are quoted at $68, Baltimore.

Steel—On most of the long term contracts for billets and sheet bars prices and deliveries have now been arranged for first quarter or first half, the tonnages taken being somewhat larger than the sellers expected. The producers now feel stronger and are disposed to ask higher prices on new contracts for first quarter. Prompt deliveries are still obtainable in a limited way at $18.50 for billets and $19 for sheet bars, f.o.b. maker's mill, Youngstown, and at 50c. higher f.o.b. maker's mill, Pittsburgh. Rods are $24.50@25, Pittsburgh.

IRON ORE

The imports of ore from Chile, brought in by the Bethlehem Steel Co. from its Tofo mines, reached a total of 45,000 tons in 1914. All of this was received at Philadelphia.

Receipts of Lake Superior ore at Lake Michigan ports in 1914 were 6,109,019 tons. The larger deliveries were 3,606,587 tons at South Chicago, 1,431,564 tons at Gary and 661,054 tons at Indiana Harbor.

COKE

Connellsville—The market is now very quiet after the recent contracting movement. Two or three contracts remain not finally closed, the prospective buyers trying out the coke. The average contract price in the movement just ended, involving about 250,000 tons a month, is little if any above $1.70. The average realized price on the merchant coke shipped out of the region in the year just ending, including foundry coke, was about $2 per ton at ovens.

Coal and Coke Tonnage of Pennsylvania R.R. lines east of Pittsburgh and Erie, 11 months ended Nov. 30, in short tons:

	1913	1914	Changes
Anthracite.....	9,699,210	10,223,221	I. 524,011
Bituminous.....	47,171,538	44,013,552	D. 3,157,986
Coke.....	13,011,863	8,926,580	D. 4,085,283
Total.....	69,882,611	63,163,353	D. 6,719,258

The total decrease in 1914 was 8.6%. The larger part of the loss was in coke tonnage.

Chemicals

NEW YORK—Dec. 29

The general chemical trade continues to show small activity and the volume of business in most lines is small.

Arsenic—The market remains dull and supplies are quite sufficient for the moderate demand. Quotations are $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is still on a moderate scale and prices are unchanged. Quotations are $4.35 per 100 lb. for carload lots and $4.60 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is quiet and no change is expected until next year. Quotations are unchanged and rather steady, at 1.85c. per lb. for all positions.

PETROLEUM

Exports of mineral oils from the United States in November are reported by the Bureau of Commerce at 168,032,001 gal. which is 1,084,449 gal. less than in November, 1913. For the 11 months ended, Nov. 30, the exports were 1,892,389,189 gal. in 1913, and 2,057,767 gal. in 1914; an increase of 165,199,578 gal., or 8.7%. The gain was chiefly in gasoline, fuel oils and residuum.

Assessments

Company	Delinq.	Sale	Amt.
Andes, Nev.	Jan. 5	Jan. 27	$0.03
Bingham Lead, Utah.	Dec. 23	Jan. 12	0.0025
Blue Bull, Nev.	Jan. 4	Feb. 8	0.01
Caledonia, Nev.	Dec. 8	Dec. 31	0.05
Cash Boy, Nev.	Jan. 15	Feb. 15	0.005
Century, Utah.	Jan. 2	Feb. 2	0.01
Clear Grit, Ida.	Jan. 12	Jan. 29	0.0015
Con. Imperial, Nev.	Dec. 23	Jan. 15	0.01
Crown Point, Nev.	Dec. 8	Dec. 29	0.05
Darby, Ida.	Dec. 14	Jan. 14	0.001
Dfd. Bk. Butte, Nev.	Dec. 1	Dec. 30	0.01
East Hercules, Ida. (post.)	Jan. 1	Feb. 1	0.001
Emerald, Utah (three instal.)	.....	June 9	0.01
Exchequer, Nev.	Dec. 21	Jan. 11	0.03
Grt. Copp. King, Utah	Dec. 21	Jan. 21	0.001
Gypsy Qn., Nev.	Jan. 12	Feb. 16	0.01
Hale and Norcross, Nev.	Dec. 14	Jan. 4	0.03
Happy Day, Ida.	Dec. 24	Jan. 25	0.0025
Hope, Calif.	Dec. 15	Jan. 11	0.05
Hypotheek, Ida.	Dec. 17	Jan. 11	0.006
Idaho-Nev., Ida.	Jan. 7	Feb. 1	0.001
Id.-Mont, Ida. (post.)	Nov. 2	Jan. 8	0.001
Keystone, Utah.	Dec. 21	Jan. 21	0.02
Laclede, Ida.	Jan. 12	Feb. 3	0.003
Lehi Tintic, Utah.	Dec. 17	Jan. 16	0.0025
MacNamara, Nev.	Jan. 12	Feb 3	0.03
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Mammoth Gold, Nev.	Nov. 23	Jan. 4	0.02
Maxfield, Utah.	Dec. 9	Dec. 30	0.0016
Nabob, Ida.	Dec. 31	Jan. 25	0.005
New Yerington, Nev.	Dec. 23	Jan. 13	0.01
O. K. Ex., Utah.	Dec. 26	Jan. 12	0.0025
O. K. Silver, Utah.	Dec. 14	Dec. 31	0.00167
Oreano, Ida.	Dec. 26	Jan. 25	0.00075
Overman, Nev.	Dec. 22	Jan. 11	0.05
Potosi, Nev.	Jan. 12	Feb. 4	0.02
Rainbow, Ida.	Nov. 30	Dec. 31	0.002
Raven, Ida.	Dec. 30	Jan. 30	0.0003
Riverside, Ida.	Dec. 20	Jan. 20	0.001
Scranton Ex., Utah.	Jan. 4	Feb. 5	0.00025
Seg. Belcher, Nev.	Dec. 16	Jan. 11	0.02
Sheba, Utah.	Jan. 12	Feb. 24	0.05
Sonora, Ida.	Nov. 30	Dec. 30	0.002
Syndicate, Ida.	Nov. 26	Dec. 28	0.001
Ton. Gip. Qn., Nev.	Jan. 12	Feb. 16	0.01
Umatilla, Nev.	Jan. 4	Feb. 8	0.01
Union Con., Nev.	Jan. 14	Feb. 4	0.05
Utah-Yerington, Nev.	Jan. 2	Jan. 23	0.0006
Wheeler, Utah.	Dec. 21	Jan. 11	0.01
Yankee Con, Utah.	Dec. 17	Jan. 4	0.01
Zuma, Utah.	Dec. 21	Jan. 12	0.0025

Stock Quotations

COLO. SPRINGS Dec. 28

Name of Comp.	Bid.
Acacia	.03¾
Cripple Cr'k Con.	.01
C. K. & N.	.05½
Doctor Jack Pot.	.11
Elkton Con.	.45
El Paso	1.59
Findlay	.02
Gold Dollar	.04½
Gold Sovereign	.04
Isabella	.13½
Jack Pot	.06½
Jennie Sample	.02
Jerry Johnson	.03½
Lexington	.004
Old Gold	.01
Mary McKinney	.41
Pharmacist	.01½
Portland	1.18
Raven B. H.	.03½
Vindicator	1.18

SALT LAKE Dec. 24

Name of Comp.	Bid.
Beck Tunnel	.05
Black Jack	.05
Colorado Mining	.10½
Crown Point	‡.01
Daly-Judge	‡4.60
Gold Chain	.08
Grand Central	.63
Iron Blossom	1.10
Little Bell	.10
Lower Mammoth	.04
Mason Valley	‡1.37½
May Day	.16½
Opohongo	‡.01½
Prince Con	.23
Seven Troughs	‡.03½
Silver King Coal'n	2.45
Silver King Con.	1.75
Sioux Con.	.02½
Uncle Sam	.05
Yankee	.07

TORONTO Dec. 28

Bailey	.01½	Foley O'Brien	.15
City of Cobalt	‡.30	Hollinger	19.85
Coniagas	5.25	Imperial	.01
Peterson Lake	.29	Jupiter	.10
Right of Way	.02	McIntyre	.24
T. & Hudson Bay	35.00	Pearl Lake	.03½
Timiskaming	.09	Porcu. Gold	.22½
Wettlaufer-Lor.	.04	Preston E. D.	.01
Big Dome	6.50	Rea	.19
Dome Exten.	.08	Seneca Superior	2.00

SAN FRANCISCO Dec. 21

Comstock Stocks		Misc. Nev. & Cal.	
Alta	.05	Belmont	4.40
Belcher	.42	Jim Butler	.71
Best & Belcher	.04	Lone Star	.13
Caledonia	.35	MacNamara	.01
Challenge Con.	.02	Midway	.07
Confidence	.19	Mont.-Tonopah	.35
Con. Virginia	.13	North Star	.16
Crown Point (Nev.)	.32	Rescue Eula	.06
Gould & Curry	.02	West End Con.	.57
Hale & Norcross	.04	Atlanta	.53
Julia	.01	Booth	.18
Mexican	.45	C.O.D. Con.	.09
Occidental	.85	Comb. Frac	.09
Ophir	.09	Jumbo Extension	2.77½
Overman	.12	Pitts.-Silver Peak	.14
Potosi	.01	Round Mountain	.44
Savage	.05	Sandstorm Kendall	.15
Sierra Nevada	.07	Silver Pick	.13
Union Con.	.10	Central Eureka	.23
Yellow Jacket	.28	So. Eureka	2.00

N. Y. EXCH. Dec. 28

Name of Comp.	Clg.
Amalgamated	52½
Am.Sm.&Ref.,com	56½
Am. Sm. & Ref., pf.	99½
Am. Sm. Sec., pf. B.	79½
Anaconda	25½
Batopilas Min.	¼
Bethlehem Steel, pf.	89
Chino	33½
Colo. Fuel & Iron	23
Federal M. & S., pf.	28½
Great Nor., ore., ctf.	24½
Guggen. Exp.	44½
Homestake	110
Inspiration Con.	16⅝
Mex. Petroleum	52
Miami Copper	17
Nat'l Lead, com.	43½
National Lead, pf.	104
Nev. Consol.	11¼
Ontario Min.	2
Phelps Dodge	175
Quicksilver, pf.	1½
Ray Con.	15⅛
Republic I&S, com.	18½
Republic I&S, pf.	75½
SlossSheffi'd, com.	23
Sloss Sheffield, pf.	82
Tennessee Copper	31½
Utah Copper	48½
U. S. Steel, com.	49⅜
U. S. Steel, pf.	104½

N. Y. CURB Dec. 28

Name of Comp.	Clg.
Beaver Con.	.21
Big Four	.08
Blue Bell	.06
Braden Copper	6
B. C. Copper	‡.50
Buffalo Mines	.95
Can. Cop. Corpn.	1½
Can. G. & S.	‡.04
Caribou	.63
Chambers Ferland	‡.13
Con. Ariz. Sm.	⅜
Coppermines Cons.	1½
Davis-Daly	.65
Diam'field-Daisy	.09
Dia. Black B.	.06½
Ely Con.	‡.01
Florence	.64
Goldfield Con.	1½
Goldfield Merger	.40
Greene Cananea	24
Kerr Lake	4½
La Rose	⅜
McKinley-Dar-Sa.	.57
Mines of Am.	2½
Mutual Min., pf.	‡2½
Nevada Hills	.10
New Utah Bingham	‡7/16
Nipissing Mines	5¼
Ohio Copper	.11
Oro	.16
Pacific Smelt	1/16
Stand'd Oil of N.J.	401
Standard S. L.	1⅞
Stewart	1 7/16
Tonopah	7⅛
Tonopah Ex.	2½
Tonopah Merger	.35
Tularosa	3/16
West End Ex.	.03
Yukon Gold	2½

LONDON Dec. 14

Name of Comp.	Clg.
Alaska Tre'dwell	£7 15s 0d
Camp Bird	0 6 0
El Oro	0 10 0
Esperanza	‡0 10 0
Mexico Mines	3 17 6
Oroville	‡0 7 6
Santa Gert'dis.	0 10 0
Tomboy	1 2 6

BOSTON EXCH Dec. 28

Name of Comp.	Clg.
Adventure	1½
Ahmeek	255
Alaska Gold M.	27
Algomah	‡.80
Allouez	.35
Am. Zinc	16¾
Ariz. Com., ctfs.	3¼
Bonanza	‡.51
Butte-Ballaklava	‡2½
Butte & Superior	35½
Calumet & Ariz.	55½
Calumet & Hecla	350
Centennial	15
Cliff	‡1
Copper Range	31½
Daly West	2½
East Butte	9
Franklin	4¼
Granby	60
Hancock	‡13¼
Helvetia	‡ 30
Indiana	‡3½
Island Cr'k, com.	‡14½
Island Cr'k, pfd.	‡86½
Isle Royale	17½
Keweenaw	‡3
Lake	5¼
La Salle	3½
Mass	‡3¾
Mayflower	4¼
Michigan	‡.75
Mohawk	47
New Arcadian	6½
New Idria Quick.	‡3½
North Butte	23¾
North Lake	1½
Ojibway	‡.75
Old Colony	‡3½
Old Dominion	44
Osceola	‡67
Quincy	53
Santa Fe	‡1½
Shannon	5
Shattuck-Ariz.	19
Superior	23
Superior & Bost.	1½
Tamarack	25½
Trinity	3½
Tuolumne	.23
U. S. Smelting	25½
U. S. Smelt'g, pf.	44
Utah Apex	2
Utah Con.	9½
Victoria	‡1½
Winona	2
Wolverine	32½
Wyandot	‡ 50

BOSTON CURB Dec. 28

Name of Comp.	Bid.
Alvarado	.60
Bingham Mines	4¼
Boston Ely	.21
Butte & Lon'n Dev.	.22
Calaveras	.93
Calumet-Corbin	.24
Chief Con.	.70
Corbin	‡1
Cortez	.15
Crown Reserve	.75
Eagle & Blue Bell	.90
First Nat. Cop.	1½
Houghton Copper	1½
Iron Cap Cop., pf.	‡5
Majestic	.17
Mexican Metals	.16
Nevada-Douglas	.60
New Baltic	1½
Oneco	.80
Raven Copper	.10
Smokey Dev.	.10
So. Lake	.04½
Tonopah Victor	‡.19
Trethewey	.12
United Verde Ext.	1½

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.573
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	58.175	28.038	27.825	26.704
June	61.290	58.990	56.471	28.215	27.199	25.948
July	60.654	58.721	54.678	27.919	27.074	25.219
August	61.606	59.293	54.344	28.375	27.335	25.979
September	63.078	60.640	53.290	29.088	27.986	24.260
October	63.471	60.793	50.654	29.299	28.083	23.199
November	62.792	58.995	49.082	29.012	27.263	22.703
December	63.365	57.760	.....	29.320	26.720	.....
Year	60.835	59.791	.....	28.042	27.576	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	71.741	64.304	77.750	69.488
February	14.971	14.491	65.519	65.259	71.575	70.188
March	14.713	14.131	65.329	64.776	70.658	69.170
April	15.291	14.211	68.111	64.747	74.273	69.313
May	15.436	13.996	68.807	63.182	74.774	67.786
June	14.672	13.603	67.140	61.336	70.821	66.274
July	14.190	13.223	64.166	60.540	69.446	64.955
August	15.400	*	69.200	‡	74.313	‡
September	16.328	*	73.125	‡	78.614	‡
October	16.337	*	73.383	‡	79.250	‡
November	15.182	11.739	68.275	53.227	73.825	*
December	14.224	.....	65.223	.....	69.583	.....
Year	15.269	.....	68.335	.....	73.740	.....

TIN

Month	New York		London	
	1913	1914	1913	1913
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.556
March	46.832	38.038	213.615	173.619
April	49.115	36.154	224.159	163.963
May	49.038	33.360	224.143	150.702
June	44.820	30.577	207.208	138.321
July	40.260	31.707	183.511	142.517
August	41.582	*	188.731	‡
September	42.410	32.675	193.074	‡
October	40.462	30.284	184.837	‡
November	39.810	33.304	180.869	139.391
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

LEAD

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	19.651
April	4.381	3.810	4.242	3.688	17.597	18.225
May	4.342	3.900	4.226	3.808	18.923	18.503
June	4.325	3.900	4.190	3.810	20.226	19.411
July	4.353	3.891	4.223	3.738	20.038	19.051
August	4.624	3.875	4.550	3.715	20.406	‡
September	4.698	3.828	4.579	3.658	20.648	‡
October	4.402	3.528	4.253	3.384	20.302	‡
November	4.293	3.683	4.146	3.585	19.334	18.500
December	4.047	.....	3.929	.....	17.798	.....
Year	4.370	.....	4.238	.....	18.743	.....

SPELTER

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6.931	5.262	6.854	5.112	26.114	21.533
February	6.239	5.377	6.089	5.228	25.338	21.413
March	6.078	5.250	5.926	5.100	24.605	21.460
April	5.641	5.113	5.491	4.963	25.313	21.569
May	5.406	5.074	5.256	4.924	24.583	21.393
June	5.124	5.000	4.974	4.850	22.143	21.345
July	5.278	4.920	5.128	4.770	20.592	21.568
August	5.658	5.568	5.508	5.418	20.706	‡
September	5.694	5.380	5.544	5.230	21.148	‡
October	5.340	4.909	5.188	4.750	20.614	‡
November	5.229	5.112	5.083	4.962	20.581	25.016
December	5.156	.....	5.004	.....	21.214	.....
Year	5.648	.....	5.504	.....	22.746	.....

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1913	1914	1913	1914	1913	1914
January	$18.15	$14.94	$17.35	$13.23	$18.59	$13.99
February	18.15	15.06	17.22	14.12	18.13	14.08
March	18.15	15.07	16.96	13.94	17.53	14.10
April	17.90	14.90	16.71	13.90	16.40	14.13
May	17.68	14.90	15.80	13.90	15.40	14.27
June	17.14	14.90	15.40	13.90	15.10	13.96
July	16.31	14.90	15.13	13.90	14.74	13.90
August	16.63	14.90	15.00	13.90	14.88	14.08
September	16.65	14.90	15.04	13.90	14.93	14.03
October	16.60	14.84	14.61	13.75	14.80	13.97
November	16.03	14.59	13.91	13.43	14.40	13.83
December	15.71	14.70	13.71	13.45	14.28	13.83
Year	$17.09	$14.88	$15.57	$13.78	$15.77	$14.01

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported. ‡ London Exchange closed.

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